



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

July 9, 2004

U.S. Army Corps of Engineers
Raleigh Regulatory Field Office
6508 Falls of Neuse Road
Suite 120
Raleigh, NC 27615

ATTN: Mr. Eric Alsmeyer
NCDOT Coordinator

Dear Sir:

SUBJECT: Permit Modification Request for TIP No. U-2527, Vance County, Western Outer Loop from SR 1128 (Ruin Creek Road) to SR 1101 (Old County Home Road) near Henderson, Federal Aid No. STP-0509(2), State Project No. 8.2390201, NCDOT Division 5, \$475 Debit WBS Element 34822.1.1.

Reference: USACE 404 Individual Permit, Action ID: 199708127, issued March 25, 2004
NCDWQ Major 401 Water Quality Certification, WQC 031494, issued February 13, 2004.
NCDWQ Buffer Certification, WQC 031494, issued February 13, 2004.

The U.S. Army Corps of Engineers (USACE) issued an Individual Permit for the above referenced project on March 25, 2004 (Action ID 199708127). This permit authorized 2,368 ft of stream impacts and 0.06 ac of wetland impacts. The N.C. Division of Water Quality (NCDWQ) issued a 401 Water Quality Certification and Tar-Pamlico River Buffer Certification for this project on February 19, 2004 (WQC Project No. 031494). This certification authorized 127,710 square feet of riparian buffer impacts in Zone 1 and 86,284 square feet of riparian buffer impacts in Zone 2.

USACE, 401 Water Quality Certification, and Tar-Pamlico River Buffer Certification special conditions direct the permittee to ensure that the construction design plans for this project do not deviate from the permit plans. It further directs the permittee to forward

any deviation in the construction design plans to the USACE and NCDWQ prior to any active construction in waters and wetlands.

The purpose of this letter is to request modifications to the CWA Section 404 Individual Permit issued by the USACE, the 401 Water Quality Certification issued by the NC Division of Water Quality (DWQ), and Riparian Buffer Certification issued by DWQ. Revised permit drawings are attached. A revised natural stream design plan is also attached.

NCDOT Division 5 has recently completed a pre-Let environmental review associated with this project. The pre-let review is based on the final roadway construction plan sheets, permit drawings and other information that may be present in the permit application. The review identified all permit drawing and plan sheet discrepancies as well as other associated constructability concerns that can be identified during the pre-construction phase of this project. The following information presents the findings of this comprehensive review. The following table summarizes old impact numbers and new impact numbers by site.

Stream Site	Buffer Site	Old Stream Impact (ft/ac)	New Stream Impact (ft/ac)	Old Buffer Impact (ac/ft ²)	New Buffer Impact (ac/ft ²)
1	1	174/0	174/0	0.39/17,054	0.39/17,054
2	2	272/0.06	272/0.06	0.53/23,037	0.53/23,037
3	3	266/0.11	266/0.13	0.49/21,520	0.55/23,958
4	4	262/0.07	262/0.07	0.17/7,521	0.17/7,521
5	5	394/0.03	410/0.03	0.57/24,662	0.57/24,662
6	6	223/0.11	233/0.11	0.34/14,601	0.34/14,601
7	7	777/0.18	777/0.18	0.80/35,056	0.82/35,719.2
	8			0.46/20,014	0.46/20,014
	9			1.16/50,529	1.20/52,272
Total		2368/0.56	2394/0.58	4.91/213,994	5.03/218,838.2

- Stream site 3, buffer site 3 (permit drawing 7, 24, and 25, plan sheet 7, Station 23+40)
 Issue: The plan sheet indicates the presence of rip rap along the northern streambank immediately upstream of the relocated channel at the inlet of the culvert. This rip rap is not depicted on the permit drawing.
 Issue: The plan sheet indicates the presence of a relocated channel, rip rap and a lateral base ditch immediately upstream of the inlet of the culvert. These impacts are not depicted on the permit drawing.
 Issue: The plan sheet indicates the presence of rip rap immediately downstream of the outlet of the culvert. The impact associated with this rip rap is not entirely depicted as a buffer impact on the permit drawing.
 Issue: There is a discrepancy in the depiction of the western fill slope between the permit drawing and the plan sheet.
 Status: The permit drawing has been modified to depict rip rap along the streambank, the additional buffer impacts and the correct fill slope. **This resulted in an increase**

of stream impact of 0.02 ac and an increase of riparian buffer impact of 0.03 ac (1306.8 square ft) in Zone 1 and 0.03 ac (1306.8 square feet) in Zone 2.

- Stream site 4, buffer site 5 (permit drawing 9 and 27, plan sheet 8, Station 26+00 to 26+30)

Issue: The plan sheet indicates that the cross pipe located at Station 26+58 is a 600mm structure. The permit drawing indicates that this cross pipe is a 450mm structure.

Issue: The plan sheet indicates the presence of a cross vane downstream of the outlet of the structure. The impact associated with the cross vane is not depicted as a buffer impact on the permit drawing.

Status: The permit drawing has been modified to depict the correct size of the structure and additional buffer impact. **This resulted in no change to stream or riparian buffer impacts.**

- Stream site 5, buffer site 7 (permit drawing 10 and 29, plan sheet 11, Station 36+72)

Issue: There is a discrepancy in the depiction of the southern fill slope between the permit drawing and the plan sheet.

Issue: The plan sheet depicts the installation of Class I rip rap along the streambank at the outlet of the cross pipe. The permit drawing depicts Class B rip rap at this location.

Issue: The plan sheet indicates the presence of rip rap at the outlet of the structure and lateral base ditches in the northwest and southwest quadrants. The impacts associated with the rip rap and the lateral base ditches are not entirely depicted as buffer impacts on the permit drawing.

Status: The permit drawing has been modified to depict the correct fill slope, size of rip rap and additional buffer impact. **This resulted in an increase of stream impact of 16.4 ft and an increase of riparian buffer impact of 0.02 ac (871.2 square ft) in Zone 2.**

- Stream site 6, buffer site 8 (permit drawing 11 and 30, plan sheet 12, erosion control sheet EC-13, Station 40+81)

Issue: The plan sheet depicts Structure 92 at Station 40+39 Rt and Structure 93 at Station 40+59 Rt. These structures are not depicted on the permit drawing.

Issue: The plan sheet depicts a Preformed Scour Hole (PSH) located outside of the riparian buffer at Station 40+90 Rt. This PSH is located inside of the riparian buffer on the permit drawing.

Issue: The tie in points of the temporary channel change as depicted on EC-13 are located outside of the permitted stream and buffer footprint as depicted on the permit drawing.

Issue: There are slight discrepancies in the depiction of the fill slopes in the northeast, northwest and southwest quadrants between the permit drawing and the plan sheet.

Issue: The plan sheet indicates the presence of rip rap at the inlet and outlet of the structure. The impact associated with the rip rap is not entirely depicted as buffer impacts on the permit drawing.

Status: The permit drawing has been modified to depict structures, the correct location of the PSH, revised stream impact, revised buffer impact, additional buffer impact and the correct fill slope. **This resulted in an increase of stream impact of 9.9 ft.**

- Stream site 7, buffer site 9 (permit drawing 12, 13, 31, and 32, plan sheet 14, Station 46+20)
Issue: The plan sheet depicts a lateral base ditch through the riparian buffer at Station 46+10 Rt. This lateral base ditch is not depicted on the permit drawing.
Issue: The plan sheet depicts a lateral base ditch at Station 46+30 Lt. This lateral base ditch is not depicted on the permit drawing.
Issue: The plan sheet depicts a 450mm cross pipe and an associated PSH at Station 47+40. The cross pipe and PSH are not depicted on the permit drawing.
Issue: The plan sheet depicts a small portion of the riparian buffer within the mechanized clearing limits of the project at Station 45+40 Rt. This buffer impact is not depicted on the permit drawing.
Status: The permit drawing has been modified to depict the lateral base ditches, cross pipe, additional buffer impact and PSH. **This resulted in an increase of riparian buffer impact of 0.03 ac (1306.8 square ft) in Zone 1 and 0.01 ac (435.6 square ft) in Zone 2.**

There will be an additional 26.3 ft (0.02 ac) of stream impacts, 0.06 ac (2613.6 square ft) of riparian buffer impacts in Zone 1, and 0.06 ac (2613.6 square ft) of riparian buffer impacts in Zone 2 due to these revisions. No additional mitigation is proposed for the additional stream impacts since the natural stream design is 2,592 ft and total revised stream impacts equal 2,394 ft. Mitigation is proposed for the additional riparian buffer impacts and NCDOT proposes to use the Ecosystem Enhancement Program for this mitigation. A copy of the request letter is attached.

The revised design does not compromise NCDOT's compliance with the existing permit conditions. No additional mitigation is proposed. The new impact sites have been evaluated for compliance with the avoidance/minimization criteria and are in compliance with all previous Individual Permit factors, including the following:

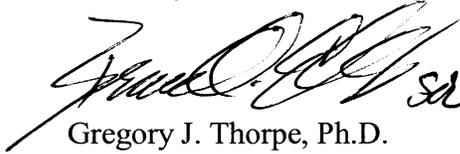
- Protected Species,
- Cultural Resources,
- Aquatic Life passage,
- FEMA compliance, and
- Utilities.

The NCDOT respectfully requests that the referenced CWA Section 404 Individual Permit, 401 Water Quality Certification, and Tar-Pamlico River Buffer Certification be modified to reflect the revisions outlined in this letter. In compliance with Section 143-215.3D(e) of the NCAC we will provide \$475 to act as payment for processing the Section 401 permit modification application previously noted in this application (see Subject line). We are providing seven copies of this application to the North Carolina

Department of Environment and Natural Resources, Division of Water Quality, for their review.

If you have any questions or need additional information, please contact Matt Haney at (919) 715-1428.

Sincerely,



Gregory J. Thorpe, Ph.D.
Environmental Management Director, PDEA

Cc: Mr. David Franklin, COE, Wilmington (Cover Letter only)
Mr. John Hennessy, DWQ Raleigh (7 copies)
Mr. Travis Wilson, NCWRC
Ms. Becky Fox, EPA
Mr. Gary Jordan, USFWS
Mr. John F. Sullivan, III, FHWA
Mr. Jay Bennett, P.E., Roadway Design
Mr. Omar Sultan, Programming and TIP
Mr. Art McMillan, P.E., Design Services
Mr. David Chang, P.E., Hydraulics
Mr. Greg Perfetti, P.E., Structure Design
Mr. Mark Staley, Roadside Environmental
Mr. J.G. Nance, P.E., Division 5 Engineer
Mr. Chris Murray, Division 5 Environmental Officer
Mr. Bill Gilmore, P.E., EEP

File: U-2527

Attachments: Revised permit drawings
Revised natural stream design plan



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

July 7, 2004

Mr. William D. Gilmore, P.E.
EEP Transition Manager
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Dear Sir:

Subject: Additional Request for Mitigation. Vance County. Western Outer Loop from SR 1128 (Ruin Creek Road) to SR 1101 (Old County Home Road) near Henderson. State Project No 8.2390201. TIP No. U-2527. NCDOT Division 5. Federal Aid Project No. STP-0509(2).

Reference: EEP request letter dated February 20, 2004.
EEP confirmation letter dated May 26, 2004.

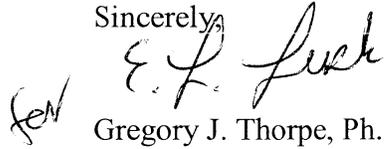
The North Carolina Department of Transportation (NCDOT) sent a letter to the North Carolina Ecosystem Enhancement Program (EEP) dated February 20, 2004 requesting that the EEP provide confirmation that you are willing to provide compensatory mitigation for the subject project. In this letter, we estimated that 214,072.7 square feet of riparian buffers will be impacted. We have since realized that there is an additional 2,613.6 square feet of riparian buffer impacts in Zone 1 and 2,613.6 square feet of riparian buffer impacts in Zone 2. Therefore, the riparian buffer impacts total 219,299.9 square feet. The riparian buffer impacts will occur adjacent to Red Bud Creek [DWQ# 28-17-2-3], a second order perennial stream, and to first and/or third order perennial streams and first order intermittent streams that are tributaries to Red Bud Creek.

We request that these impacts be included in the original request sent on February 20, 2004.

In order to satisfy regulatory assurances that mitigation will be performed, the NCDWQ requires a formal letter from EEP indicating their willingness and ability to provide the mitigation work requested by NCDOT. The NCDOT requests such a letter of confirmation be addressed to Mr. John Hennessy of NCDWQ, with copies submitted to NCDOT.

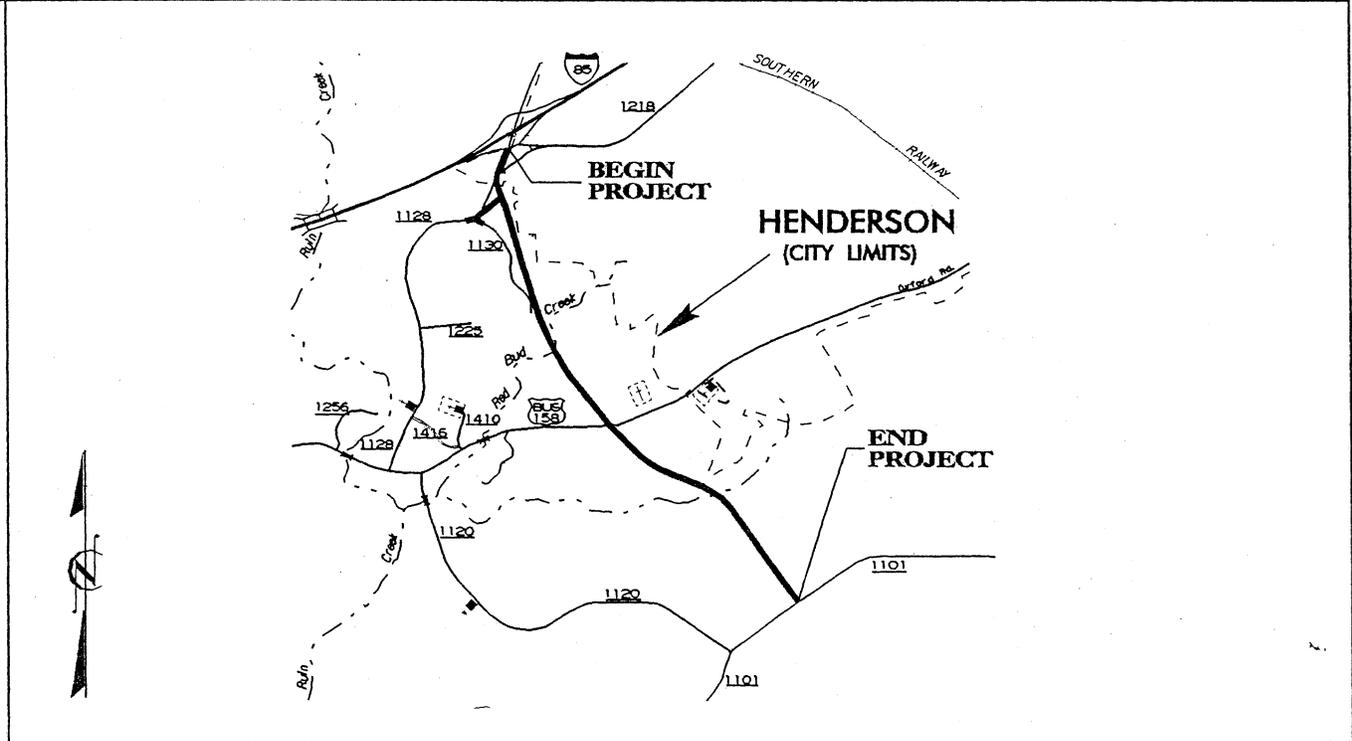
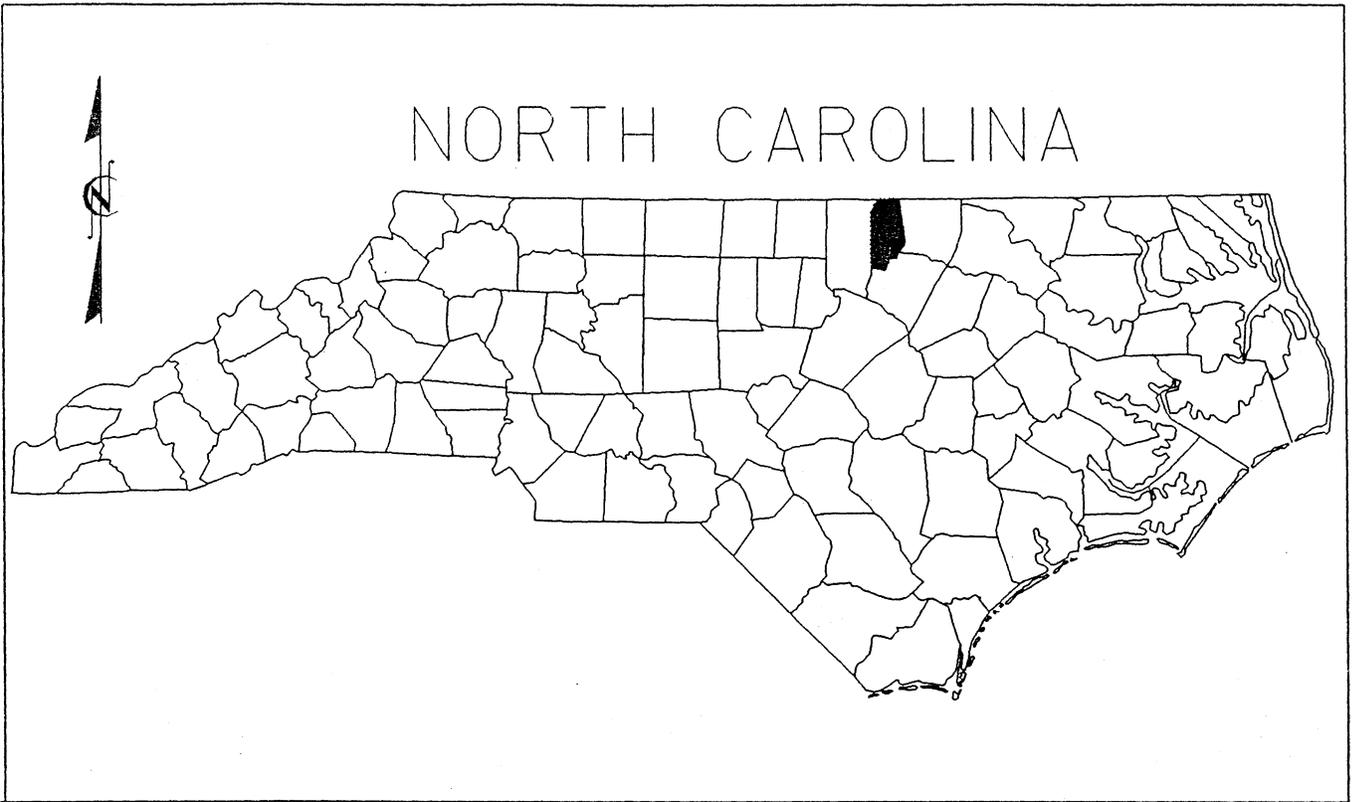
If you have any questions or need additional information please call Matt Haney at (919) 715-1428.

Sincerely,

A handwritten signature in black ink, appearing to read "G. J. Thorpe". The signature is written in a cursive style with a large initial "G".

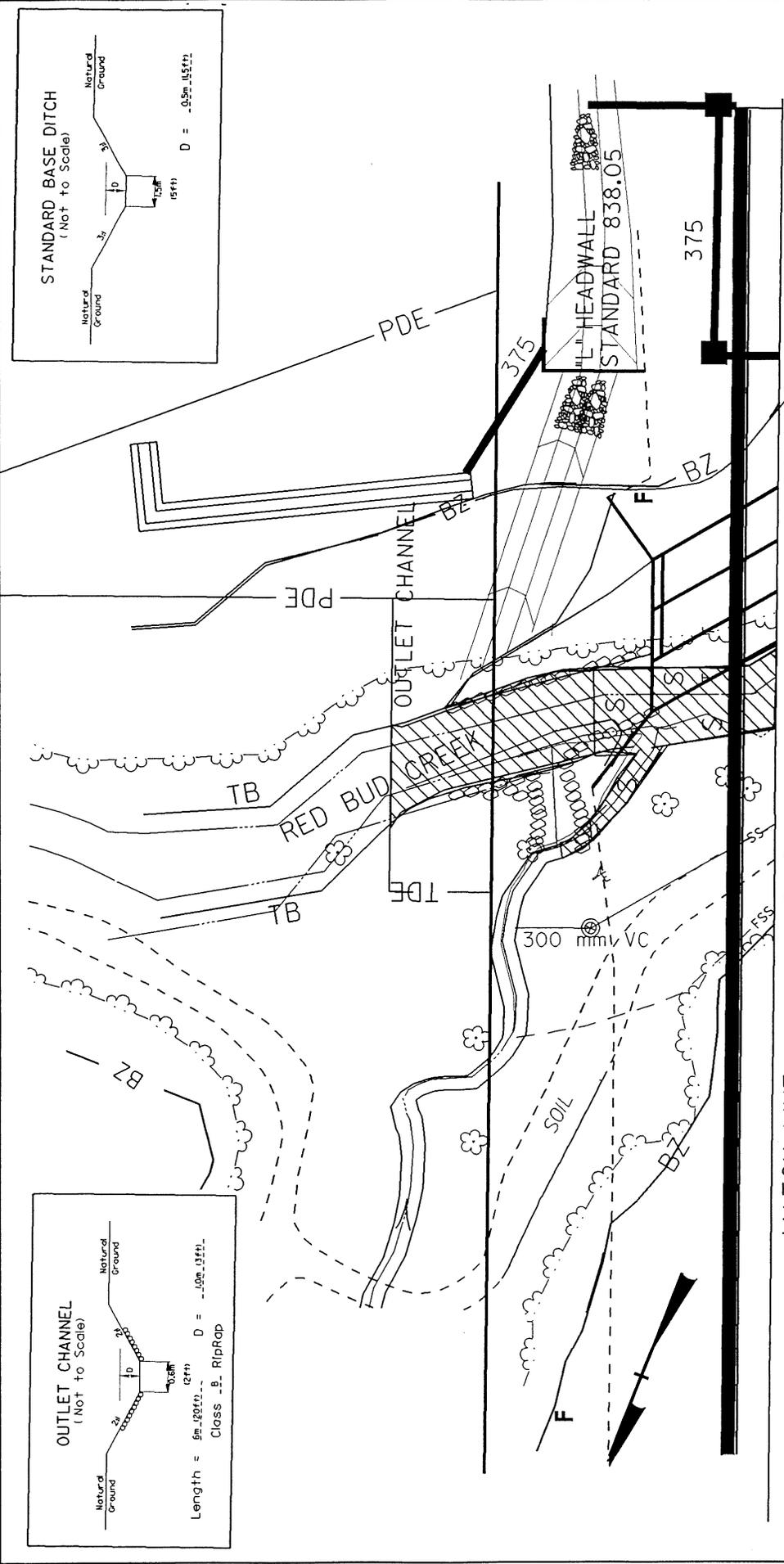
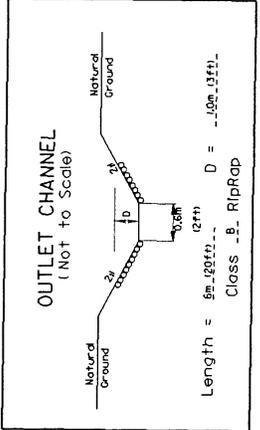
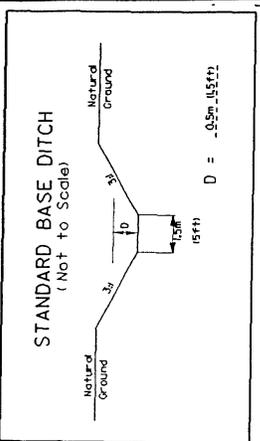
Gregory J. Thorpe, Ph.D.,
Environmental Management Director
Project Development & Environmental Analysis Branch

cc: Mr. John Hennessy, Division of Water Quality
Mr. Gary Jordan, USFWS
Mr. Travis Wilson, NCWRC
Mr. David Franklin, USACE, Wilmington
Mr. Eric Alsmeyer, USACE
Ms. Beth Harmon, EEP, Raleigh



STREAM AND
WETLANDS IMPACTS
VICINITY
MAPS

NCDOT
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2390201 (U-2527)
HENDERSON WESTERN
OUTER LOOP FROM
SR 1128 TO SR 1101
SHEET 1 OF 41 03/15/02



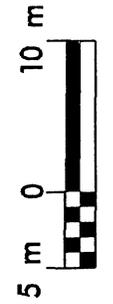
NC DOT
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2290201 (U-2527)
HENDERSON WESTERN
OUTER LOOP FROM
SR 1128 TO SR 1101
REV 06//04
3/16/02

MATCH LINE A

3 @ 3.6m X 2.7m RCBC
 Depth bkf = 0.5m (1.6ft)
 Width bkf = 5.4m (17.7ft)
 Area bkf = 2.3 m² (24.8sq.ft.)

23+00

23+60



SITE 3
PLAN VIEW



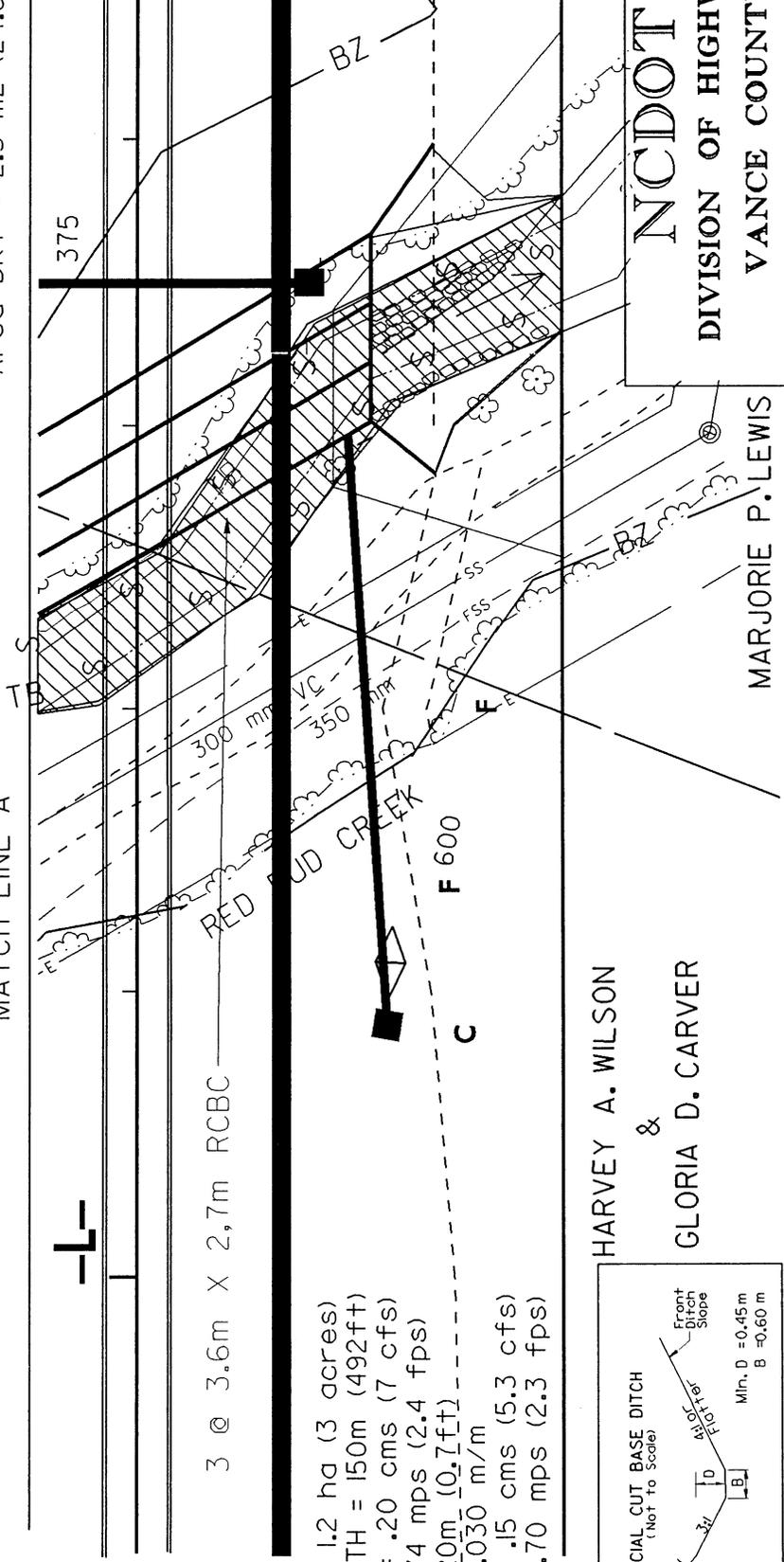
23+00

23+60

3 @ 3.6m X 2.7m RCBC
 Depth bkf = 0.5m (1.6ft)
 Width bkf = 5.4m (17.7ft)
 Area bkf = 2.3 m² (24.8sq.ft.)

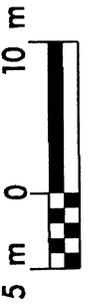
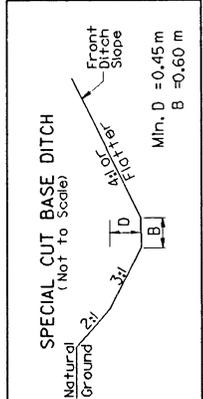
MATCH LINE A

MATCH STATION 23+90



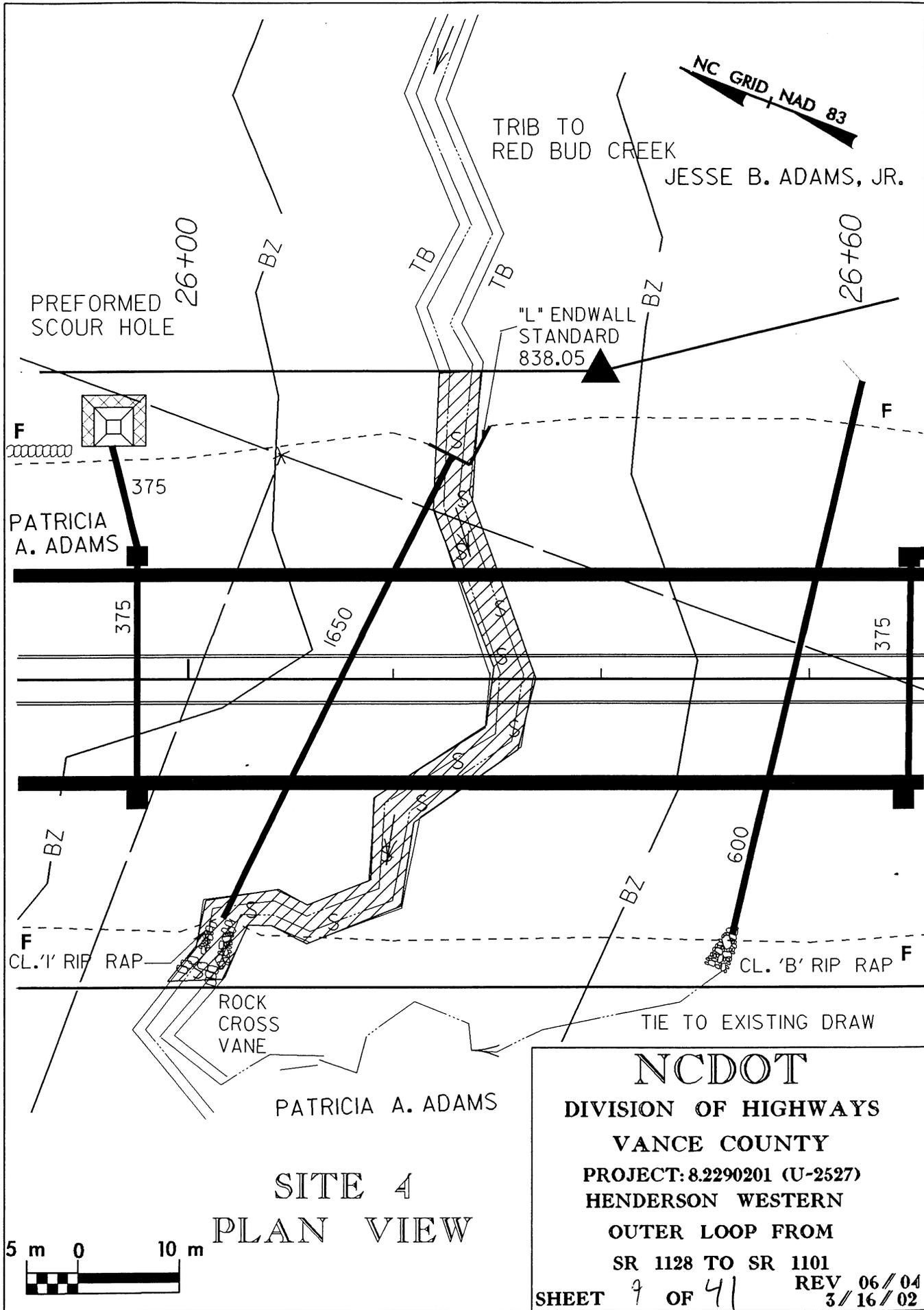
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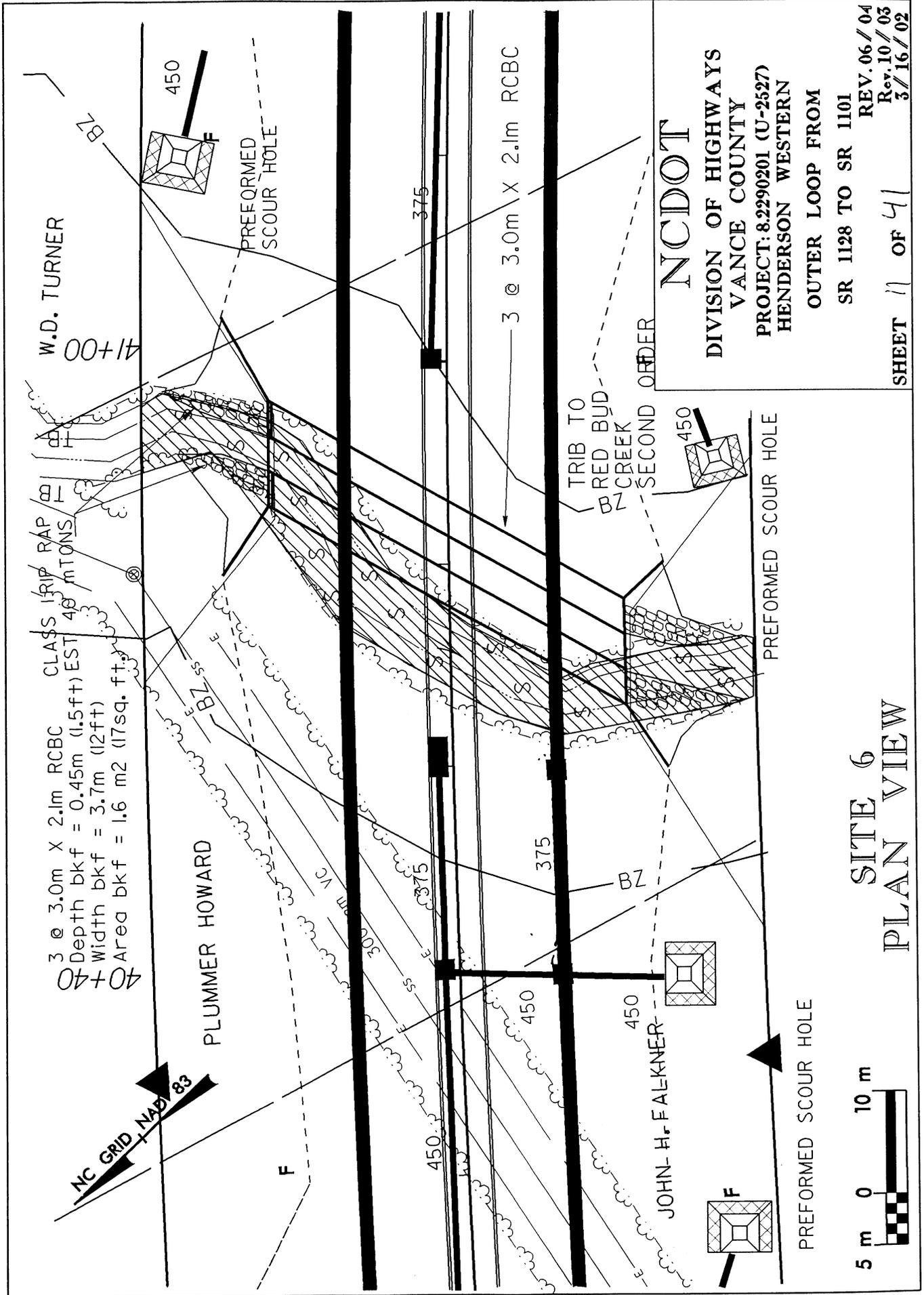
DA = 1.2 ha (3 acres)
 LENGTH = 150m (492ft)
 Q10 = .20 cms (7 cfs)
 V = .74 mps (2.4 fps)
 D = .20m (0.7ft)
 S = 0.030 m/m
 Q2 = .15 cms (5.3 cfs)
 V = .70 mps (2.3 fps)



SITE 3
 PLAN VIEW

NCDOT
 DIVISION OF HIGHWAYS
 VANCE COUNTY
 PROJECT: 8.2290201 (U-2527)
 HENDERSON WESTERN
 OUTER LOOP FROM
 SR 1128 TO SR 1101
 REV 06/04
 SHEET 8 OF 41 3/16/02





W.D. TURNER
41+00

CLASS 1 RIP RAP EST 48 TONS
3 @ 3.0m X 2.1m RCBC
Depth bkf = 0.45m (1.5ft)
Width bkf = 3.7m (12ft)
Area bkf = 1.6 m² (17sq. ft.)
40+40

PLUMMER HOWARD

NC GRID NAD 83

PERFORMED SCOUR HOLE

3 @ 3.0m X 2.1m RCBC

TRIBUTARY TO RED BUD CREEK SECOND ORDER

PERFORMED SCOUR HOLE

JOHN H. FALKNER

PERFORMED SCOUR HOLE

NCDOT
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2290201 (U-2527)
HENDERSON WESTERN
OUTER LOOP FROM

SR 1128 TO SR 1101

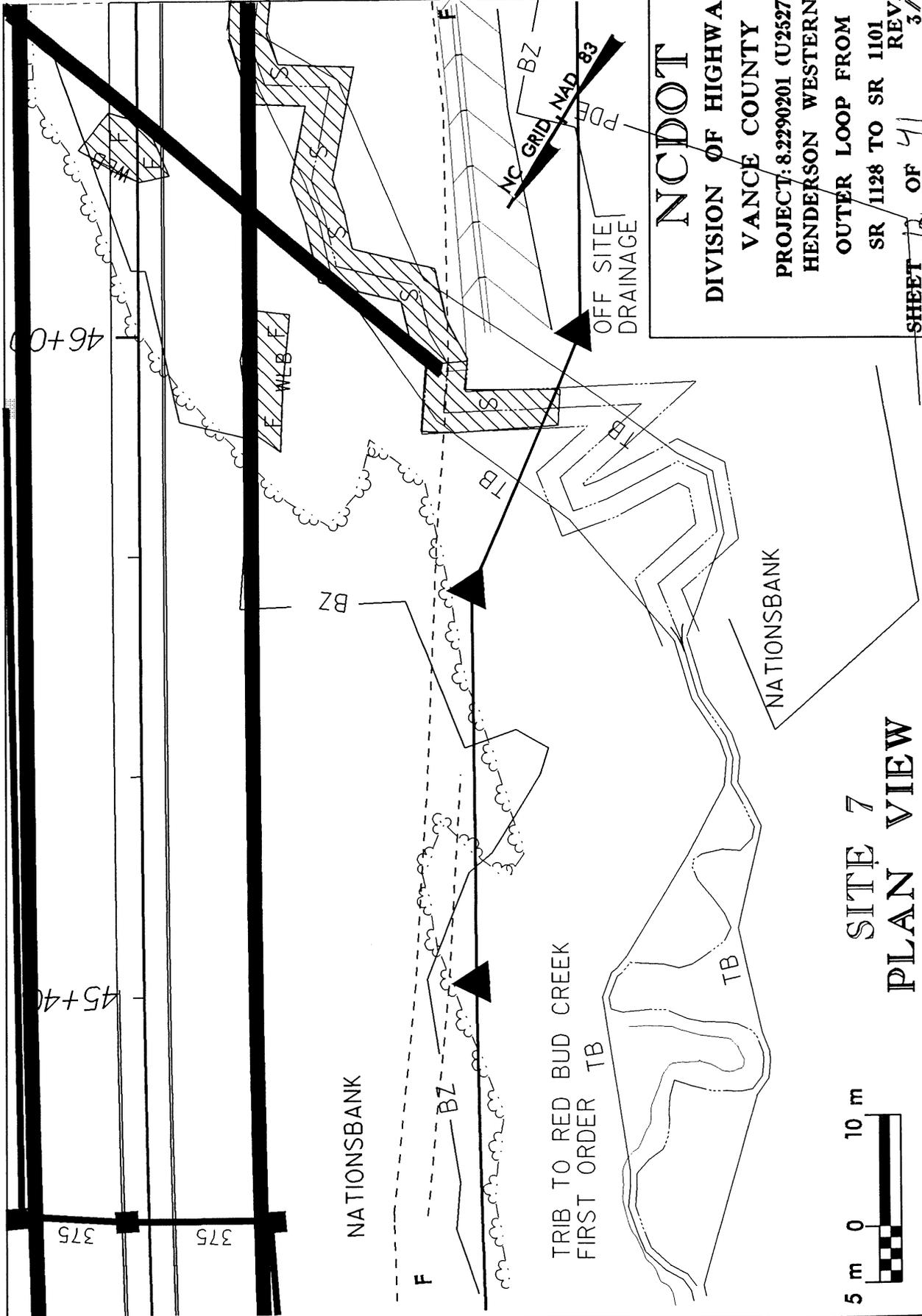
REV. 06 / 04
Rev. 10 / 03
3 / 16 / 02

SHEET 11 OF 41

SITE 6
PLAN VIEW

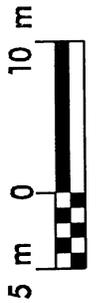


MATCH STATION 46+30



NCDOT
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2290201 (U2527)
HENDERSON WESTERN
OUTER LOOP FROM
SR 1128 TO SR 1101
REV. 06 / 04
3 / 16 / 02

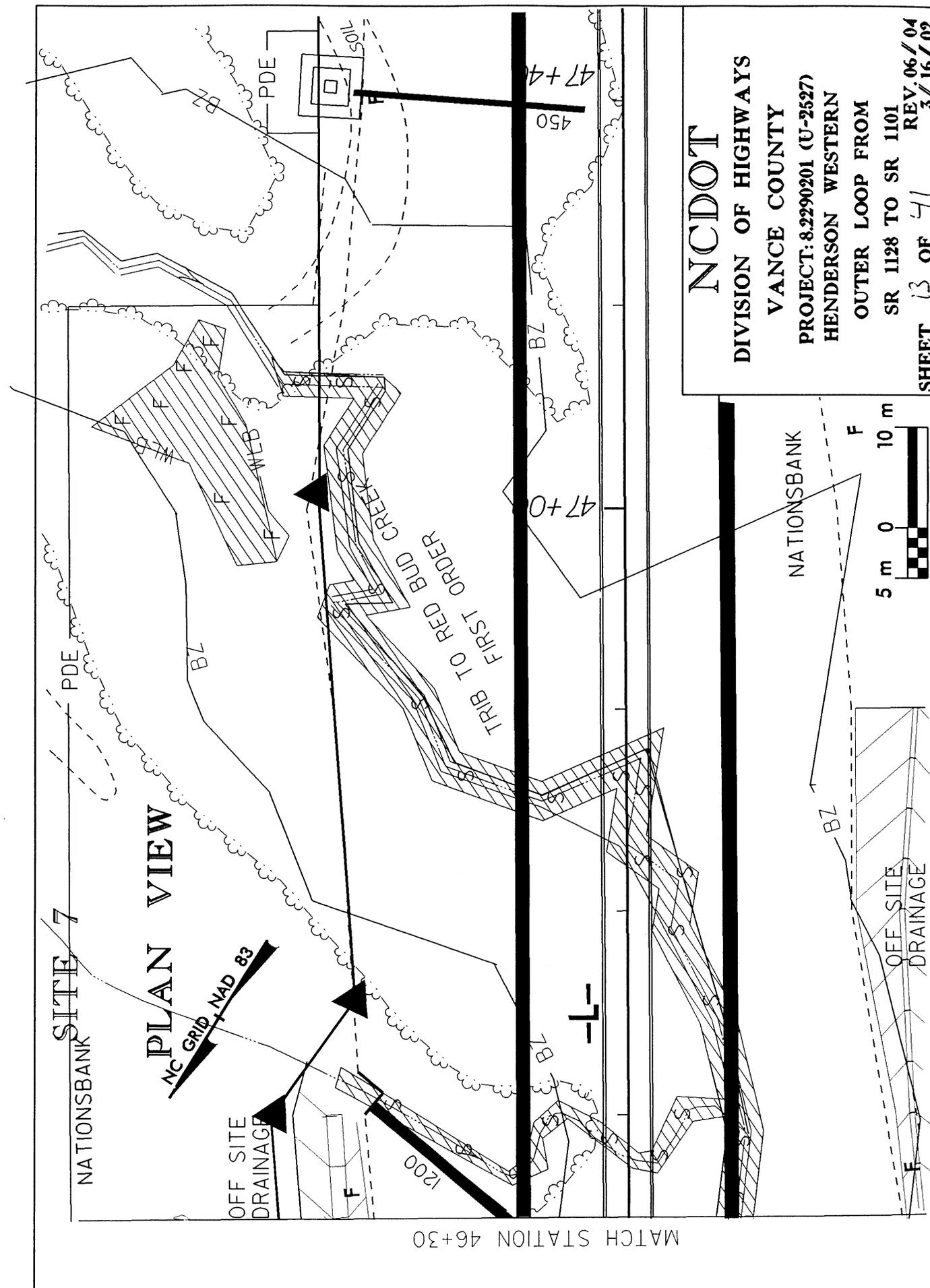
SITE 7
PLAN VIEW



SHEET 12 OF 41

SITE 7

PLAN VIEW



MATCH STATION 46+30

NCDOT

DIVISION OF HIGHWAYS
VANCE COUNTY

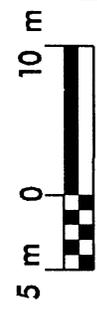
PROJECT: 8.2290201 (U-2527)
HENDERSON WESTERN

OUTER LOOP FROM
SR 1128 TO SR 1101

REV. 06/04
3/16/02

SHEET 13 OF 41

NATIONS BANK



BZ

OFF SITE
DRAINAGE

F

WETLAND PERMIT IMPACT SUMMARY

Site No.	Station (From/To)	Structure Size / Type	WETLAND IMPACTS				SURFACE WATER IMPACTS						
			Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation In Wetlands (ac)	Mechanized Clearing (Method III) (ac)	Fill In SW (Natural) (ac)	Fill In SW (Pond) (ac)	Temp. Fill In SW (ac)	Existing Channel Impacted (ft)	Natural Stream Design (ft)		
1	18+40 -L-	600 RCP					0.00					173.8	
2	21+30 -L-	600 RCP					0.06					272.2	
3	23+40 -L-	CULVERT					0.13					265.7	
4	26+00 to 26+30 -L-	1500 RCP					0.07					262.4	
5	36+72 -L-	900 RCP					0.03					410.0	
6	40+81 -L-	CULVERT					0.11					232.9	
7	46+20 -L-	1500 RCP	0.06				0.18					777.4	
TOTALS:			0.06	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.00	2394.4	0.0

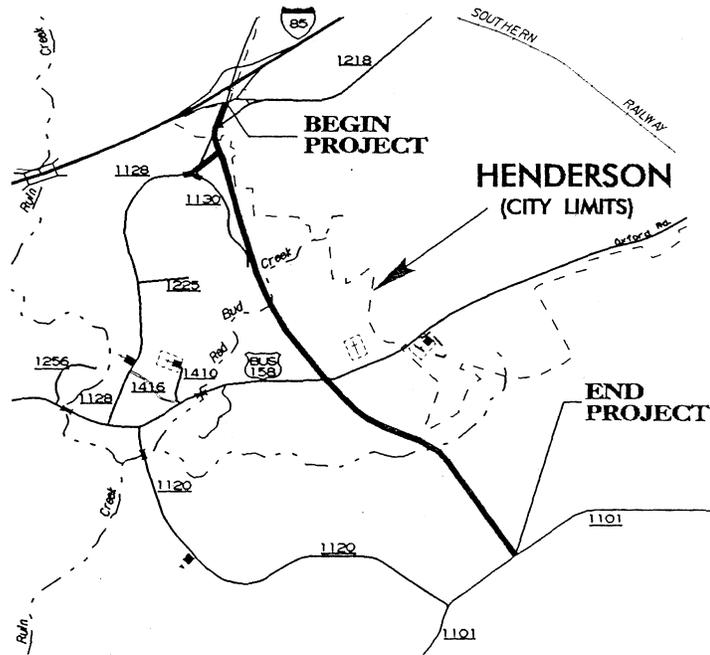
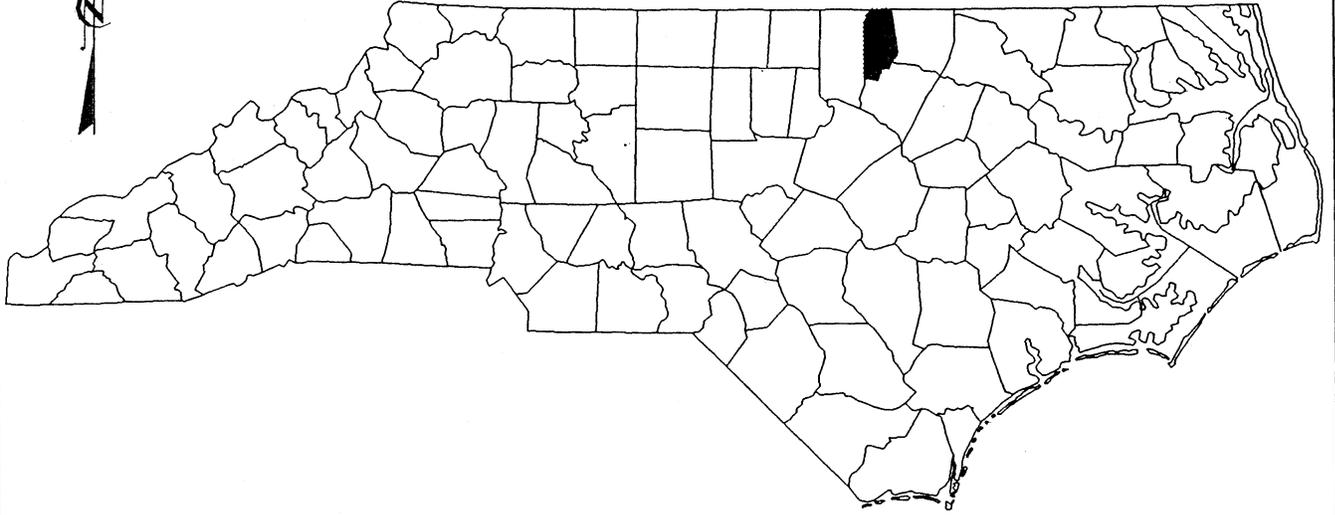
NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

VANCE COUNTY
PROJECT 8.2290201 U-2527

REV.06/04
/2002 Rev.1

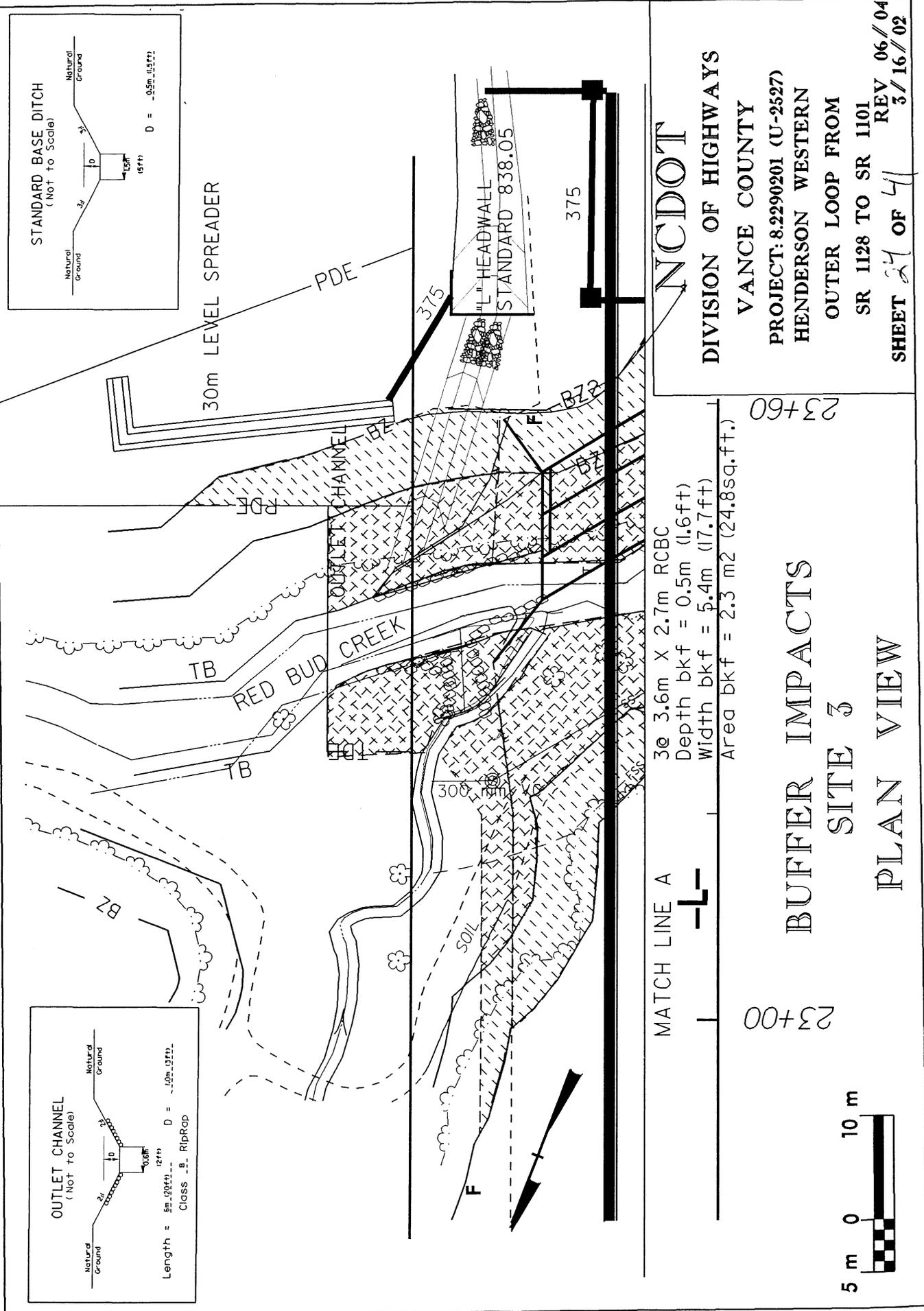
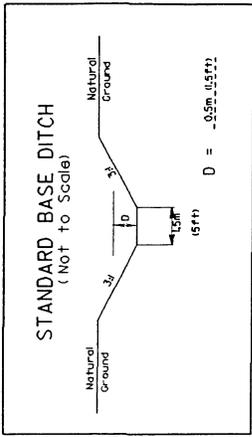
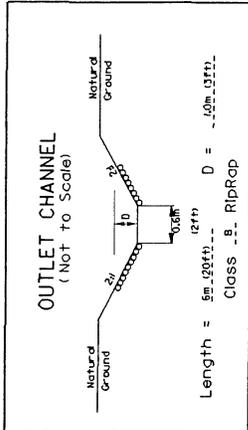
SHEET 14 of 41

NORTH CAROLINA



BUFFER IMPACTS VICINITY MAPS

NCDOT
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2390201 (U-2527)
HENDERSON WESTERN
OUTER LOOP FROM
SR 1128 TO SR 1101



MATCH LINE A

3 @ 3.6m X 2.7m RCBC
 Depth bkf = 0.5m (1.6ft)
 Width bkf = 5.4m (17.7ft)
 Area bkf = 2.3 m² (24.8sq.ft.)



23+00

23+60



BUFFER IMPACTS
 SITE 3
 PLAN VIEW

NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

OUTER LOOP FROM

SR 1128 TO SR 1101

SHEET 24 OF 41

REV 06/04
 3/16/02

23+00

23+60

3 @ 3.6m X 2.7m RCBC
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Width bkf = 5.4m (17.7ft)
Area bkf = 2.3 m2 (24.8sq.ft.)

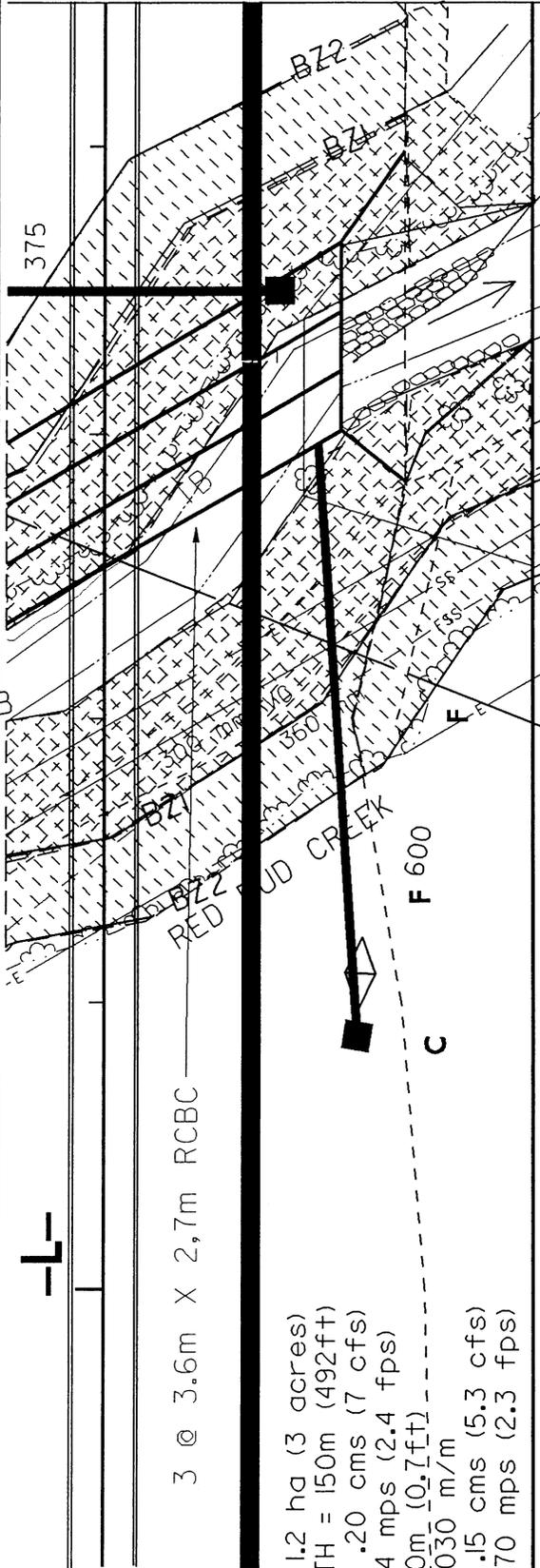
MATCH LINE A

MATCH STATION 23+90

-L-

3 @ 3.6m X 2,7m RCBC

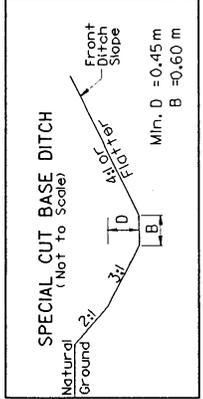
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Q2 = .15 cms (5.3 cfs)
V = .70 mps (2.3 fps)



HARVEY A. WILSON
&
GLORIA D. CARVER

MARJORIE P. LEWIS

BUFFER IMPACTS SITE 3 PLAN VIEW



NCDOT

DIVISION OF HIGHWAYS

VANCE COUNTY

PROJECT: 8.2290201 (U-2527)

HENDERSON WESTERN

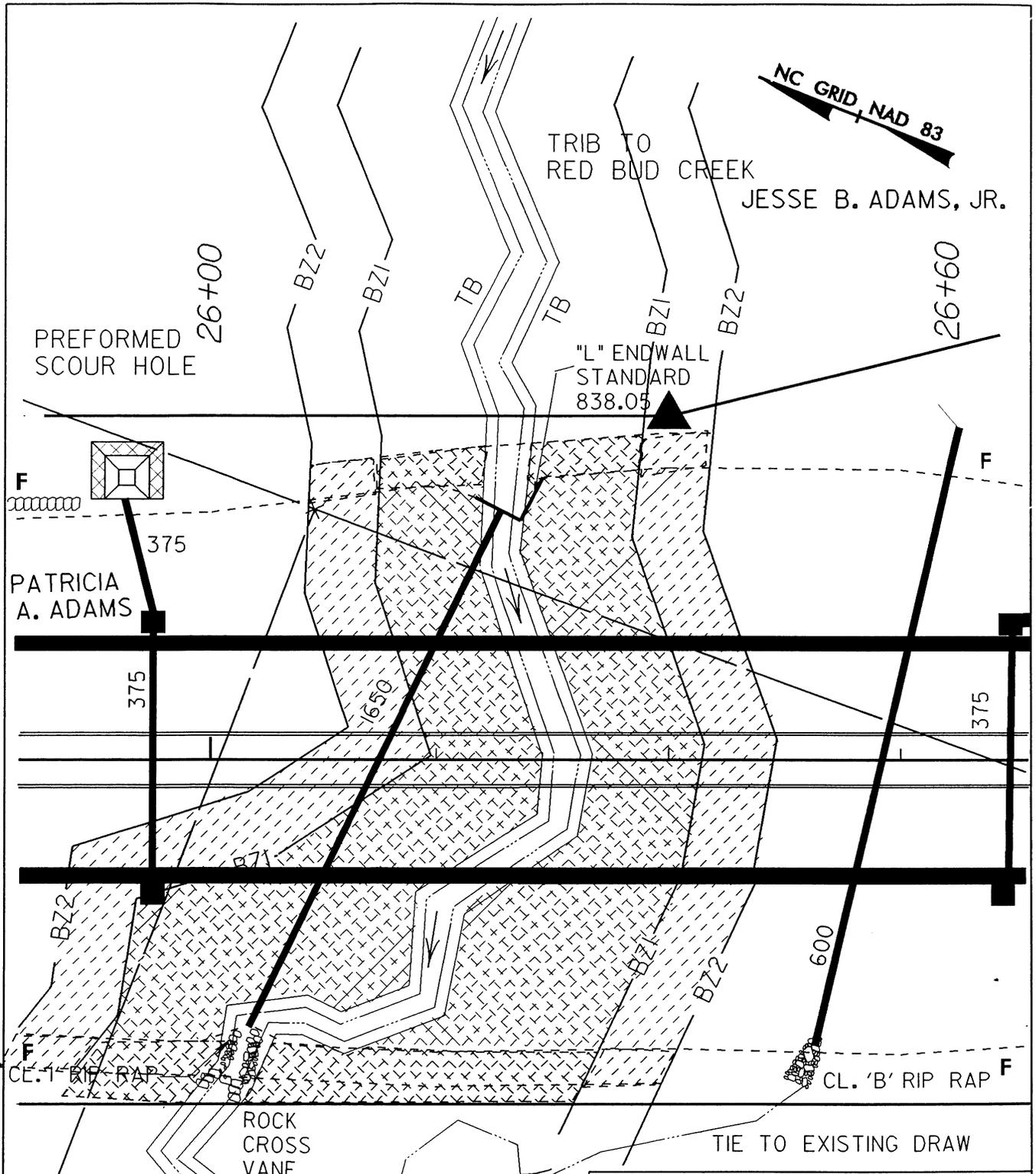
OUTER LOOP FROM

SR 1128 TO SR 1101

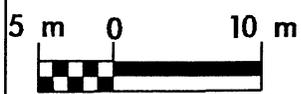
REV 06/04

SHEET 25 OF 41

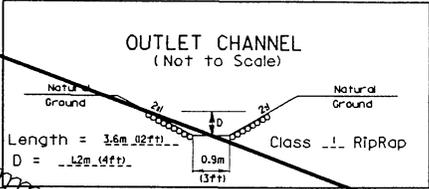
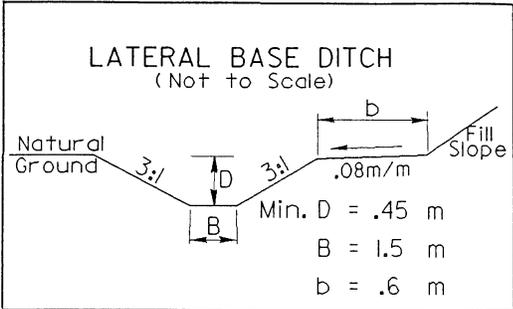
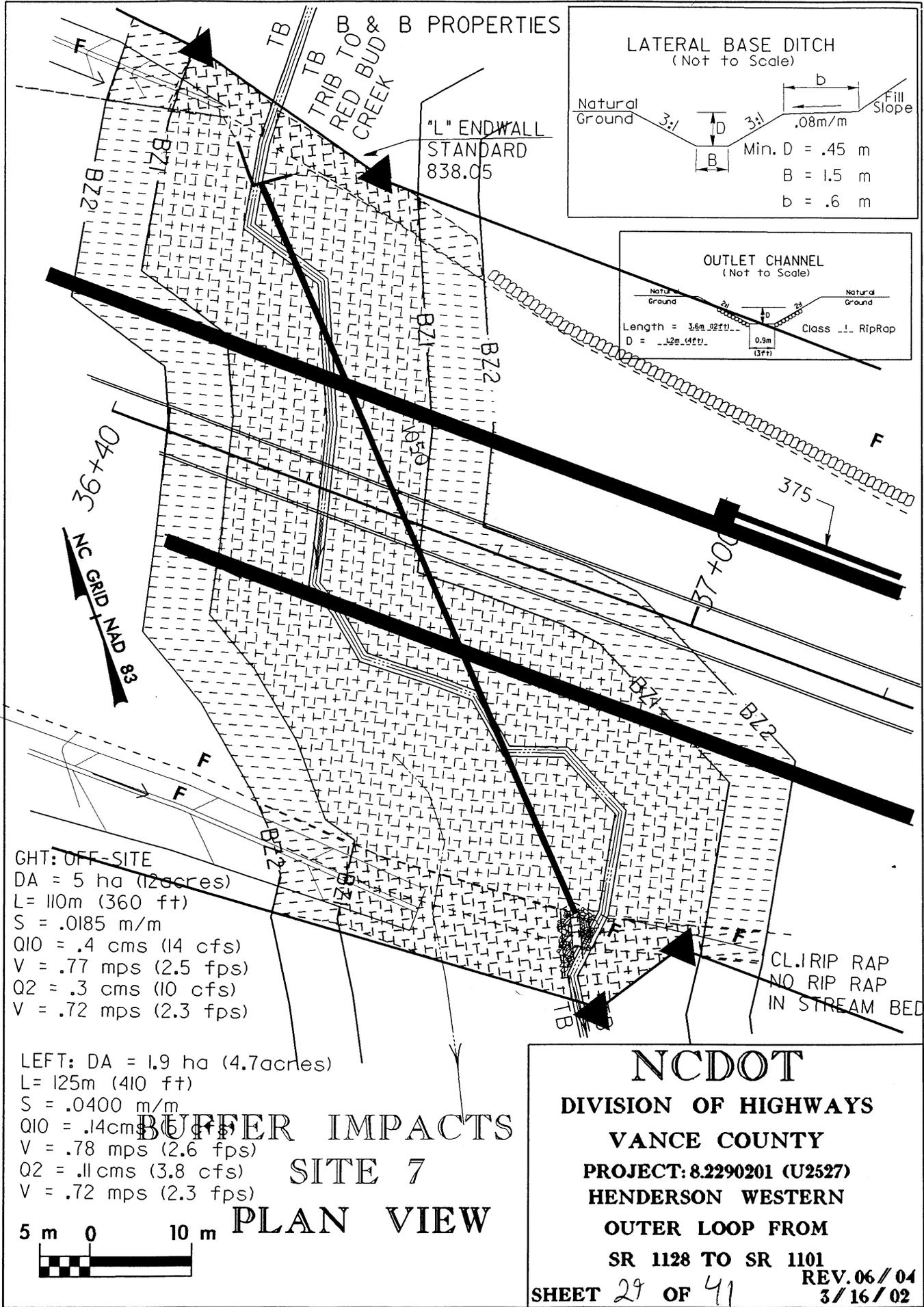
3/16/02



PATRICIA A. ADAMS
 BUFFER IMPACTS
 SITE 5
 PLAN VIEW



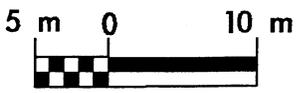
NCDOT
 DIVISION OF HIGHWAYS
 VANCE COUNTY
 PROJECT: 8.2290201 (U-2527)
 HENDERSON WESTERN
 OUTER LOOP FROM
 SR 1128 TO SR 1101
 SHEET 27 OF 41
 REV 06//04
 3//16//02



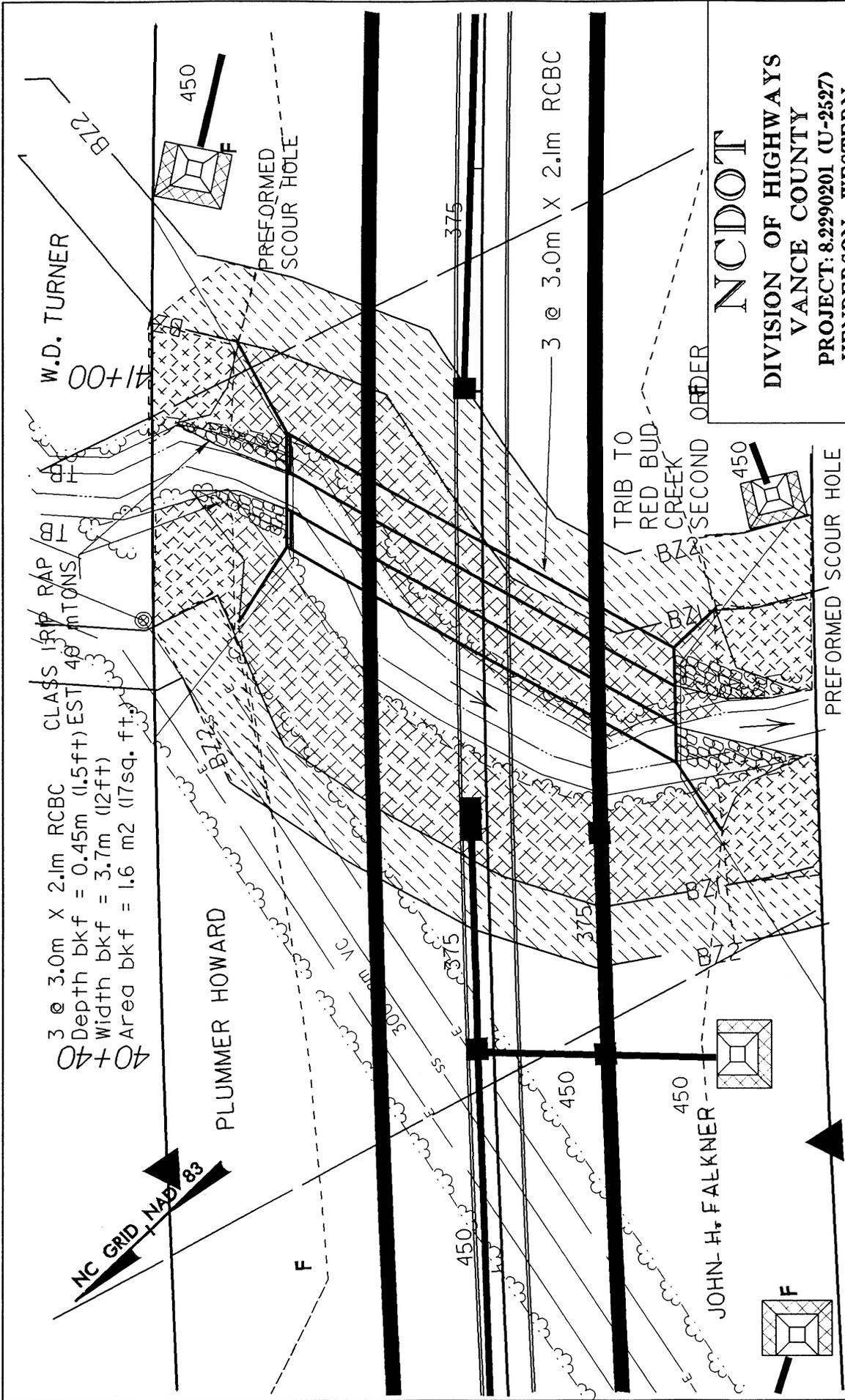
GHT: OFF-SITE
 DA = 5 ha (12 acres)
 L = 110m (360 ft)
 S = .0185 m/m
 Q10 = .4 cms (14 cfs)
 V = .77 mps (2.5 fps)
 Q2 = .3 cms (10 cfs)
 V = .72 mps (2.3 fps)

LEFT: DA = 1.9 ha (4.7 acres)
 L = 125m (410 ft)
 S = .0400 m/m
 Q10 = .14 cms (5 cfs)
 V = .78 mps (2.6 fps)
 Q2 = .11 cms (3.8 cfs)
 V = .72 mps (2.3 fps)

BUFFER IMPACTS
SITE 7
PLAN VIEW



NCDOT
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2290201 (U2527)
HENDERSON WESTERN
OUTER LOOP FROM
SR 1128 TO SR 1101
SHEET 29 OF 41
 REV. 06 / 04
 3 / 16 / 02



3 @ 3.0m X 2.1m RCBC CLASS 1 RP RAP 40 TONS
 Depth bkf = 0.45m (1.5ft) EST 40 TONS
 Width bkf = 3.7m (12ft)
 Area bkf = 1.6 m² (17sq. ft.)

W.D. TURNER

PLUMMER HOWARD

JOHN-H. FALKNER

TRIB TO RED BUD CREEK

ORDER

NCDOT

DIVISION OF HIGHWAYS
 VANCE COUNTY
 PROJECT: 8.2290201 (U-2527)
 HENDERSON WESTERN

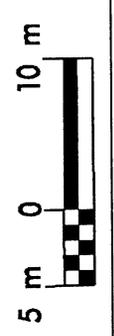
OUTER LOOP FROM
 SR 1128 TO SR 1101

REV. 06 / 04
 Rev. 10 / 03
 3 / 16 / 02

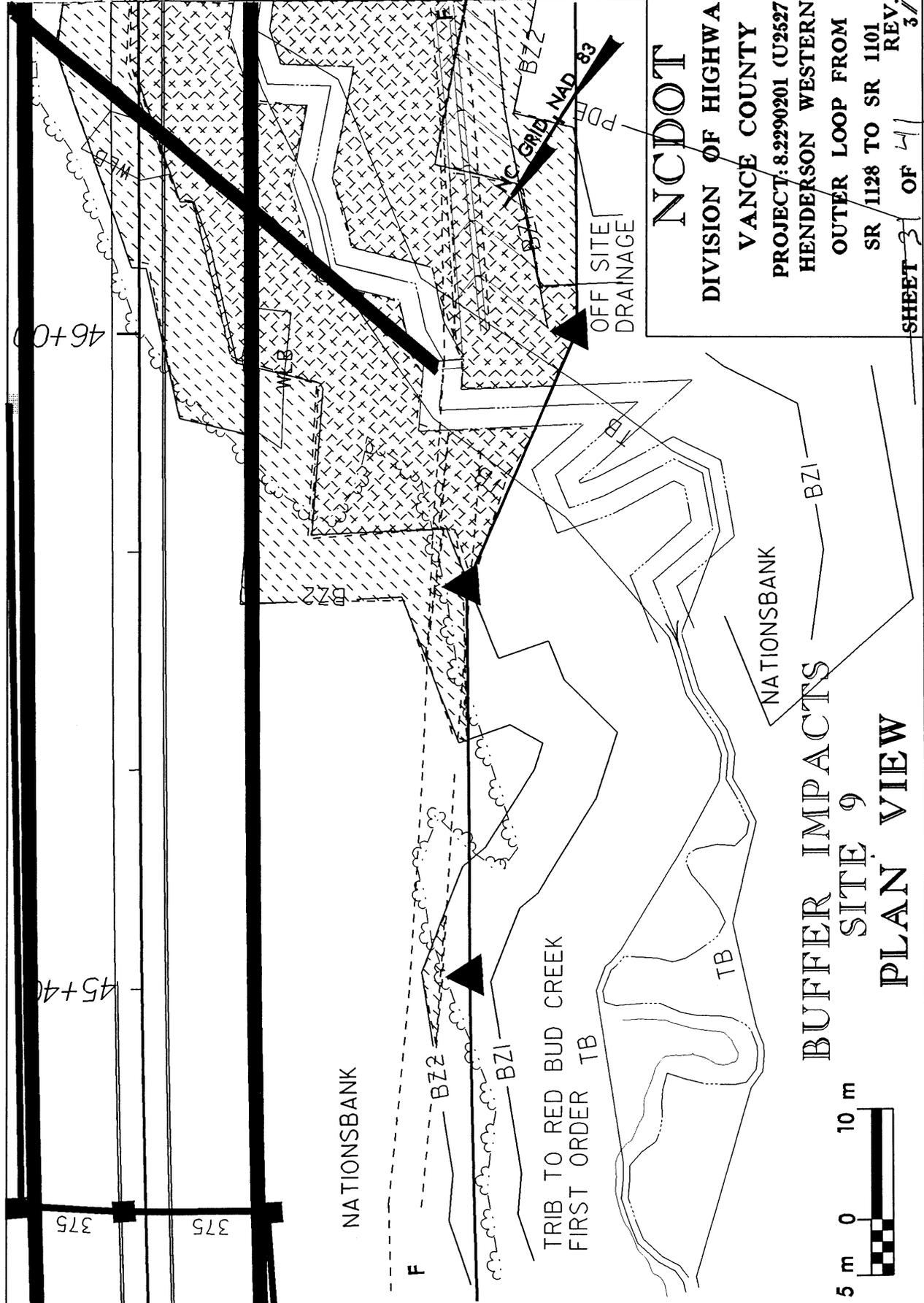
SHEET 30 OF 41

BUFFER IMPACTS
 SITE 8
 PLAN VIEW

PREFORMED SCOUR HOLE

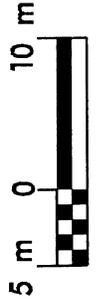


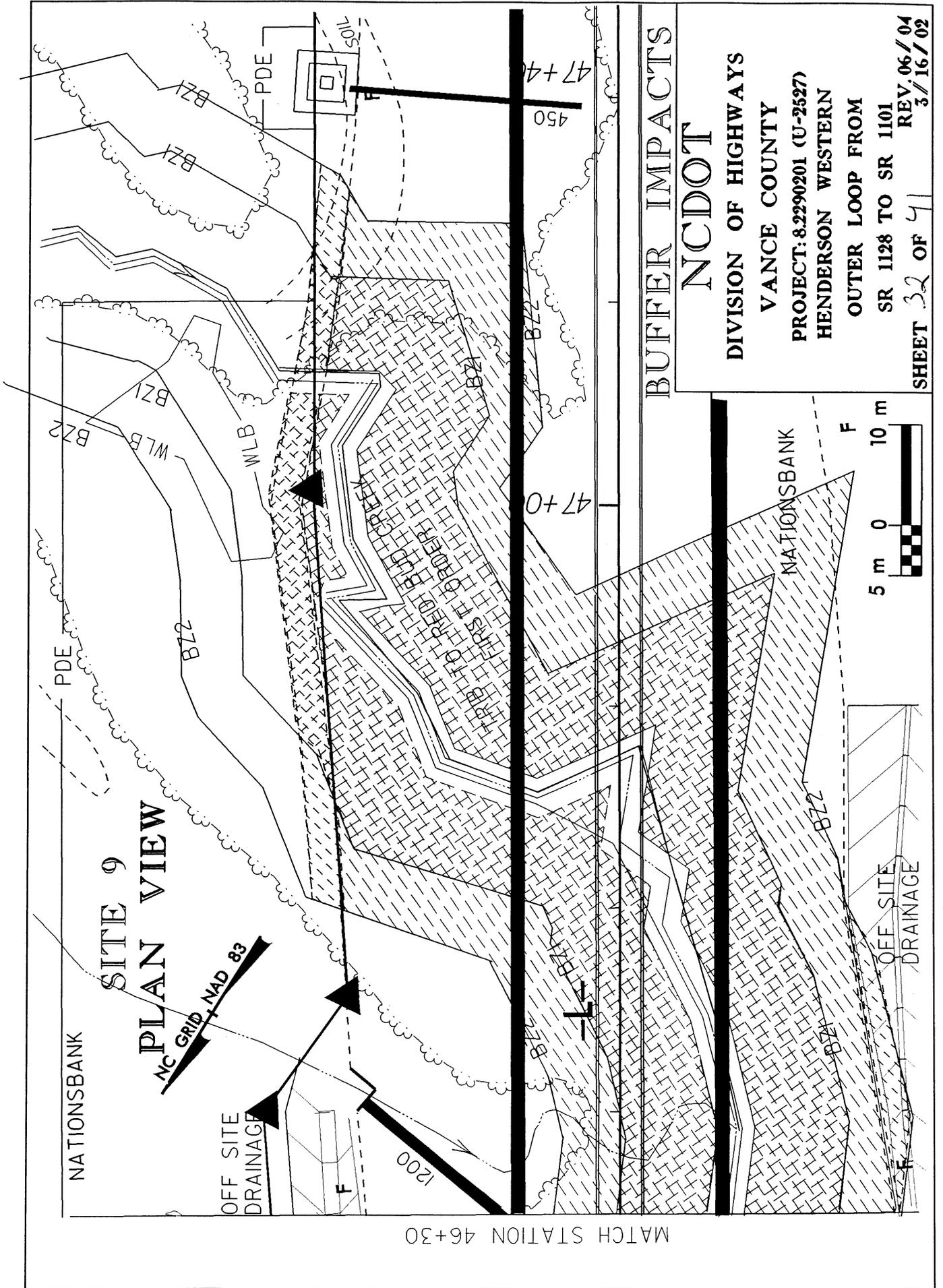
MATCH STATION 46+30



NC DOT
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2290201 (U2527)
HENDERSON WESTERN
OUTER LOOP FROM
SR 1128 TO SR 1101
REV. 06 / 04
3 / 16 / 02

BUFFER IMPACTS
SITE 9
PLAN VIEW





BUFFER IMPACTS

NC DOT

DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2290201 (U-2527)
HENDERSON WESTERN
OUTER LOOP FROM
SR 1128 TO SR 1101
REV. 06/04
3/16/02

Stream Mitigation Plan
U-2527 Vance County
June 22, 2004

This project involves restoration of approximately 790 m. (2592ft.) of an unnamed tributary to Red Bud Creek. The proposed Western Outer Loop near Henderson is unavoidably impacting Red Bud Creek as well as its tributaries along the proposed alignment. The proposed restoration will be used to mitigate these impacts. The existing stream flows through cut over woods with uncut trees along the stream. The stream has low riffle/ pool sequence and sinuosity. The side slopes are 1:1 in some areas and eroded in pool areas. The existing stream reach is entrenched and most nearly fits the geomorphic characteristics of a G4 stream type (see Morphological Measurement Table). At the confluence of the tributary to Red Bud Creek and the proposed stream, bedrock exist and will prevent any further down cutting at the confluence. With this in mind it is proposed to restore the unnamed tributary to its original dimension, pattern, and profile to the extent practicable by installing grade control structures in a riffle pool sequence at the confluence thus exposing the tributary to its original floodplain.

The drainage area contributing to the project site is 0.16 sq.mi. The drainage area for the proposed restoration for the most part lies between the main tributary to the north, NC SR 1101 to the south, and approximately 2000 feet east of the proposed outer loop. This drainage basin is totally wooded and cut over for the most part. Currently there is no development in the basin. Development in the future would encompass approximately 10 to 15 percent of the drainage basin. The stream extends approximately 1200 feet upstream of the site.

As stated above the existing stream is entrenched. Morphological data was difficult to collect on the existing stream but was attempted and is shown on the Morphological Measurement Table. Pebble counts were conducted at two locations and the D50 size material was approximately 0.031 inches (.79 mm). The bankfull depth and width were determined for the existing stream so that a bankfull discharge could be developed for design purposes.

The reference stream for the proposed project is Silas Creek near Winston Salem in Forsyth County (see attachments for verification of reference reach material). The drainage area for Silas Creek is 3.30 sq.mi. Morphological ratios from the reference stream in conjunction with natural stream design techniques from the Applied River Morphology book by Dave Rosgen and bankfull depth from the existing stream were used to extrapolate pertinent data to the proposed stream. Silas Creek best fits the geomorphic characteristics of a B4c/1 stream type (see Morphological Measurement Table).

The proposed stream reach has a drainage area of 0.16 sq.mi. and will be 791m (2595ft.) long. The width/depth ratio was adjusted to 13.00 so that the stream could be constructed as a B4c stream type. The existing stream shall be backfilled with the most impervious

material available. Shear calculations indicate that the existing bed material will need to be supplemented to increase the d50 size material such that the calculated shear is slightly higher than the permissible shear for the bed. The riffles for the proposed stream shall consist of a mixture of 10% Class “B”, 60% Class “A” stone and 30% #57 stone (See Constructed Riffle Detail). This will insure motion of the bed load and reduce the possibility of degrading the riffles (see shear calculations).

Sediment Transport:

The following is a summary of the shear stress and stream power for the proposed stream restoration. The shear calculations come from the HYCHL program in the FHWA Integrated Drainage Design Computer System, Version 6.0 (HYDRAIN). HYCHL can analyze channels for stability through application of tractive force theory. The program compares shear exerted on the lining with the permissible shear stress of the lining. HYCHL can analyze composite linings (i.e. a bed lining and a side slope lining). Attached are the results calculated by HYCHL for the existing and proposed stream, having a natural cobble bed lining and vegetative side slope lining. The results were determined for the proposed bankfull elevation. The results indicate a stable side slope lining and an unstable bed lining for the existing bed material (d50=0.031in.). It would take a d50 = 4.0in to increase the permissible shear too slightly less than the bed shear. The increase in bed material size will insure motion of the bed load and reduce the possibility of degrading the riffles.

Stream power in lb/ft-s is given by the equation $\omega = \tau V$, where: τ is the average channel shear stress in lb/ft² given by HYCHL.

	<u>STREAM POWER</u>	<u>BED SHEAR</u>	<u>SIDE SHEAR</u>	<u>PERMISSIBLE SHEAR</u>	
				Bed	Side
Existing D50 = 0.031in	3.99	0.95	0.51	0.33	2.10
Proposed D50 = 4.0in	2.44	1.18	0.78	1.65	2.10

Commands Read From File: u2527b4e.chl

EXISTING STREAM

```

JOB U-2527 FIRST ORDER TRIBUTARY
UNI 0
** UNITS PARAMETER = 0 (ENGLISH)
   CHL 0.0162 27
   TRP 6.03 2
** LEFT SIDE SLOPE 2.0 AND RIGHT SIDE SLOPE 2.0
** THE BASE WIDTH OF THE TRAPEZOID (ft) 6.03
   N .03 .08
** LOW FLOW N VALUE= .030
** SIDE SLOPE N VALUE= .080
   LRR .031
** D50 (ft) .03
   CPS .5
   LVG B
   PSS .33 2.10
** USER SUPPLIED - LOW PERMIS. SHEAR = (lb/ft^2) .33
** USER SUPPLIED - HIGH PERMIS. SHEAR = (lb/ft^2) 2.10
END
    
```

*****END OF COMMAND FILE*****

U-2527 FIRST ORDER TRIBUTARY

INPUT REVIEW

```

DEFAULT ANGLE OF REPOSE (degrees): 33.98
DESIGN PARAMETERS:
  DESIGN DISCHARGE (ft^3/s): 27.00
  CHANNEL SHAPE: TRAPEZOIDAL
  CHANNEL SLOPE (ft/ft): .016
  LINING TRANSITION HEIGHT (ft): .50
    
```

HYDRAULIC CALCULATIONS USING NORMAL DEPTH

	DESIGN	MAXIMUM
	-----	-----
FLOW (cfs)	27.00	.00
DEPTH (ft)	.94	.00
AREA (ft^2)	7.39	.00
WETTED PERIMETER (ft)	10.21	6.03
HYDRAULIC RADIUS (ft)	.72	.00
VELOCITY (ft/s)	3.65	.00
MANNINGS N (LOW FLOW)	.030	.030
MANNINGS N (SIDE SLOPE)	.080	.080
EFFECTIVE MANNINGS N	.042	.030
REYNOLDS NUMBER (10^5)	.01	

*** WARNING: Davg/D50 <= 2 FOR THE MAXIMUM DISCHARGE PROCEDURE.
Qmax MAY BE INCORRECT BECAUSE IT REQUIRES BATHURST

STABILITY ANALYSIS

CONDITION	LINING TYPE	PERMIS SHR (lb/ft^2)	CALC. SHR (lb/ft^2)	STAB. FACTOR	REMARKS
-----	-----	-----	-----	-----	-----
LOW FLOW LINING					
BOTTOM; STRAIGHT	RIPRAP	.33	.95	.35	UNSTABLE
SIDE SLOPE LINING					
SIDE; STRAIGHT	VEGETATIVE B	2.10	.51	4.15	STABLE

RATIO OF SIDE SHEAR TO BOTTOM SHEAR = .54

*** NORMAL END OF HYCHL ***

Commands Read From File: u2527b4p.chl

PROPOSED STREAM

```

JOB U-2527 FIRST ORDER TRIBUTARY
UNI 0
** UNITS PARAMETER = 0 (ENGLISH)
   CHL 0.0162 27
   TRP 6.03 2
** LEFT SIDE SLOPE 2.0 AND RIGHT SIDE SLOPE 2.0
** THE BASE WIDTH OF THE TRAPEZOID (ft) 6.03
   N .055 .08
** LOW FLOW N VALUE= .055
** SIDE SLOPE N VALUE= .080
   LRR .33
** D50 (ft) .33
   CPS .5
   LVG B
   PSS 1.65 2.10
** USER SUPPLIED - LOW PERMIS. SHEAR = (lb/ft^2) 1.65
** USER SUPPLIED - HIGH PERMIS. SHEAR = (lb/ft^2) 2.10
END
*****END OF COMMAND FILE*****
    
```

U-2527 FIRST ORDER TRIBUTARY

INPUT REVIEW

```

DEFAULT ANGLE OF REPOSE (degrees): 40.95
DESIGN PARAMETERS:
  DESIGN DISCHARGE (ft^3/s): 27.00
  CHANNEL SHAPE: TRAPEZOIDAL
  CHANNEL SLOPE (ft/ft): .016
  LINING TRANSITION HEIGHT (ft): .50
    
```

HYDRAULIC CALCULATIONS USING NORMAL DEPTH

	DESIGN	MAXIMUM
FLOW (cfs)	27.00	48.08
DEPTH (ft)	1.17	1.63
AREA (ft^2)	9.74	15.17
WETTED PERIMETER (ft)	11.24	13.33
HYDRAULIC RADIUS (ft)	.87	1.14
VELOCITY (ft/s)	2.77	3.17
MANNINGS N (LOW FLOW)	.055	.055
MANNINGS N (SIDE SLOPE)	.080	.080
EFFECTIVE MANNINGS N	.062	.065
REYNOLDS NUMBER (10^5)	.25	

STABILITY ANALYSIS

CONDITION	LINING TYPE	PERMIS SHR (lb/ft^2)	CALC. SHR (lb/ft^2)	STAB. FACTOR	REMARKS
LOW FLOW LINING BOTTOM; STRAIGHT	RIPRAP	1.65	1.18	1.40	STABLE
SIDE SLOPE LINING SIDE; STRAIGHT	VEGETATIVE B	2.10	.78	2.71	STABLE

RATIO OF SIDE SHEAR TO BOTTOM SHEAR = .66

*** NORMAL END OF HYCHL ***

<i>Variables</i>	<i>Existing Channel</i>	<i>Proposed Reach</i>	<i>USGS Station</i>	<i>Reference Reach</i>
1. Stream type	G4	B4c	NONE	B4c/1
2. Drainage area (D.A.) (ac.)	102.5 ac.	102.5 ac.		2112 ac.
3. Bankfull width (W_{bkf}) (ft.)	5.26 ft.	10.27 ft.		25.58 ft.
4. Bankfull mean depth (d_{bkf}) (ft.)	1.04 ft.	0.79 ft.		1.69 ft.
5. Width/depth ratio (W_{bkf}/d_{bkf})	5.06	13.00		15.11
6. Bankfull cross-sectional area (A_{bkf}) (ft ²)	5.47 ft ²	8.11 ft ²		43.30 ft ²
7. Bankfull mean velocity (V_{bkf}) (ft/s)	4.84 ft/s	2.77 ft/s		4.6 ft/s
8. Bankfull discharge (Q_{bkf}) (ft ³ /s)	26.50 ft ³ /s	27.00 ft ³ /s		199 ft ³ /s
9. Bankfull max depth (d_{mbkf}) (ft)	1.47 ft.	1.06 ft.		3.0 ft
10. Width of floodprone area (W_{fpa}) (ft)	2.95 ft.	20.87 ft.		36.58 ft
11. Entrenchment ratio (W_{fpa}/W_{bkf})	0.56	2.03		1.43
12. Meander length (L_m) (ft)	62.57 ft.	65.10 ft.		168.3 ft
13. Ratio of meander length to bankfull width (L_m/W_{bkf})	11.90	6.34		6.57
14. Radius of curvature (R_c) (ft)	8.04 ft.	21 ft.		41.18 ft
15. Ratio of radius of curvature to bankfull width (R_c/W_{bkf})	1.53	2.04		1.61
16. Belt width (W_{bit}) (ft)	26.02 ft.	26.51 ft.		43.7 ft
17. Meander width ratio (W_{bit}/W_{bkf})	4.95	2.58		1.71
18. Sinuosity (stream length/valley length) (K)	1.35	1.18		1.07
19. Valley Slope (VS)	.0196	.0191		0.0088
20. Average slope (CS)	.0145	.0162		0.0094
21. Pool slope	.0142	.005		0.0004
22. Ratio of pool slope to average slope	.01	.31		.04
23. Maximum pool depth (dp_{max}) (ft)	1.80 ft.	1.80 ft.		5.0 ft
24. Ratio of pool depth to average bankfull depth (dp/d_{bkf})	1.73	2.28		1.57
25. Pool width (W_p) (ft)	3.29 ft.	12.02 ft.		25.84 ft
26. Ratio of pool width to bankfull width	.63	1.17		1.01
27. Pool to pool spacing (ft)	23.83 ft.	36.30 ft.		62.4 ft
28. Ratio of pool to pool spacing to bankfull width	4.53	3.53		2.44
29. Ratio of lowest bank height to bankfull height (or max bankfull depth) (BH_{low}/d_{mbkf})	1.00	1.00		1.00

NATURAL CHANNEL DESIGN DATA
MORPHOLOGICAL MEASUREMENT
TABLE (ENGLISH UNITS)

* Reference reach is Silas Creek near Winston Salem in Forsyth County, NC.

SITE 1

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
VANCE COUNTY
PROJECT: 8.2390201 (U-2527)

June 16, 2004
SHEET __ OF __

Pebble Count

Project: 8.2390201

Sheet # 5 of 6

TIP No.: U-2527

Comm. No.: _____

Pebble Count

	Particle	mm	PARTICLE COUNT			Total #	Item %	% Cum.
			1	2	3			
	Silt/Clay	<.062	11	1		12	6.8	6.8
(Sand)	Very Fine	.062-.125	15	1		16	9.1	15.9
	Fine	.125-.25	14	32		46	26.1	42.0
	Medium	.25-.50	6			6	3.4	45.5
	Coarse	.50-1.0	2	10		12	6.8	52.3
	Very Coarse	1.0-2	4	1		5	2.8	55.1
(Gravel)	Very Fine	2.0-4.0	4	8		12	6.8	61.9
	Fine	4.0-5.7	3	5		8	4.5	66.5
	Fine	5.7-8.0	3	3		6	3.4	69.9
	Medium	8.0-11.3	3	9		12	6.8	76.7
	Medium	11.3-16.0	5	4		9	5.1	81.8
	Coarse	16.0-22.6	9			9	5.1	86.9
	Coarse	22.6-32.0	10			10	5.7	92.6
	Very Coarse	32-45				0	0.0	92.6
	Very Coarse	45-64	3			3	1.7	94.3
(Cobble)	Small	64-90	4			4	2.3	96.6
	Small	90-128				0	0.0	96.6
	Large	128-180	1			1	0.6	97.2
	Large	180-256				0	0.0	97.2
(Boulder)	Small	256-362				0	0.0	97.2
	Small	362-512				0	0.0	97.2
	Medium	512-1024				0	0.0	97.2
	Lg-Very Lg	1024-2048	2			2	1.1	98.3
(Bedrock)			3			3	1.7	100.0
TOTALS						176		100.0

D₁₆: 0.13 mm

Sand &< 55 %

D₃₅: 0.21 mm

Gravel 39 %

D₅₀: 0.79 mm

Cobble 3 %

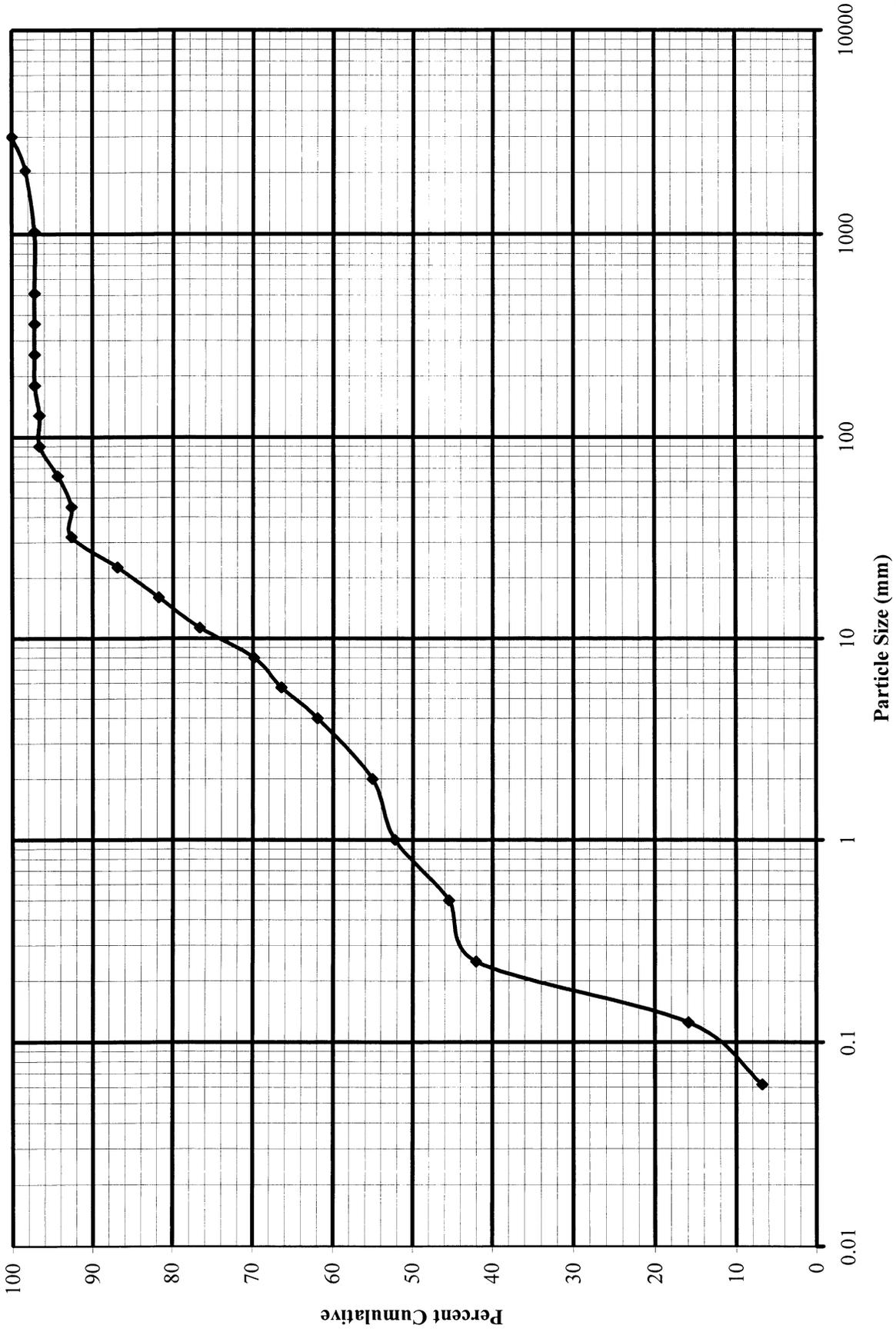
D₈₄: 18.57 mm

Boulder 1 %

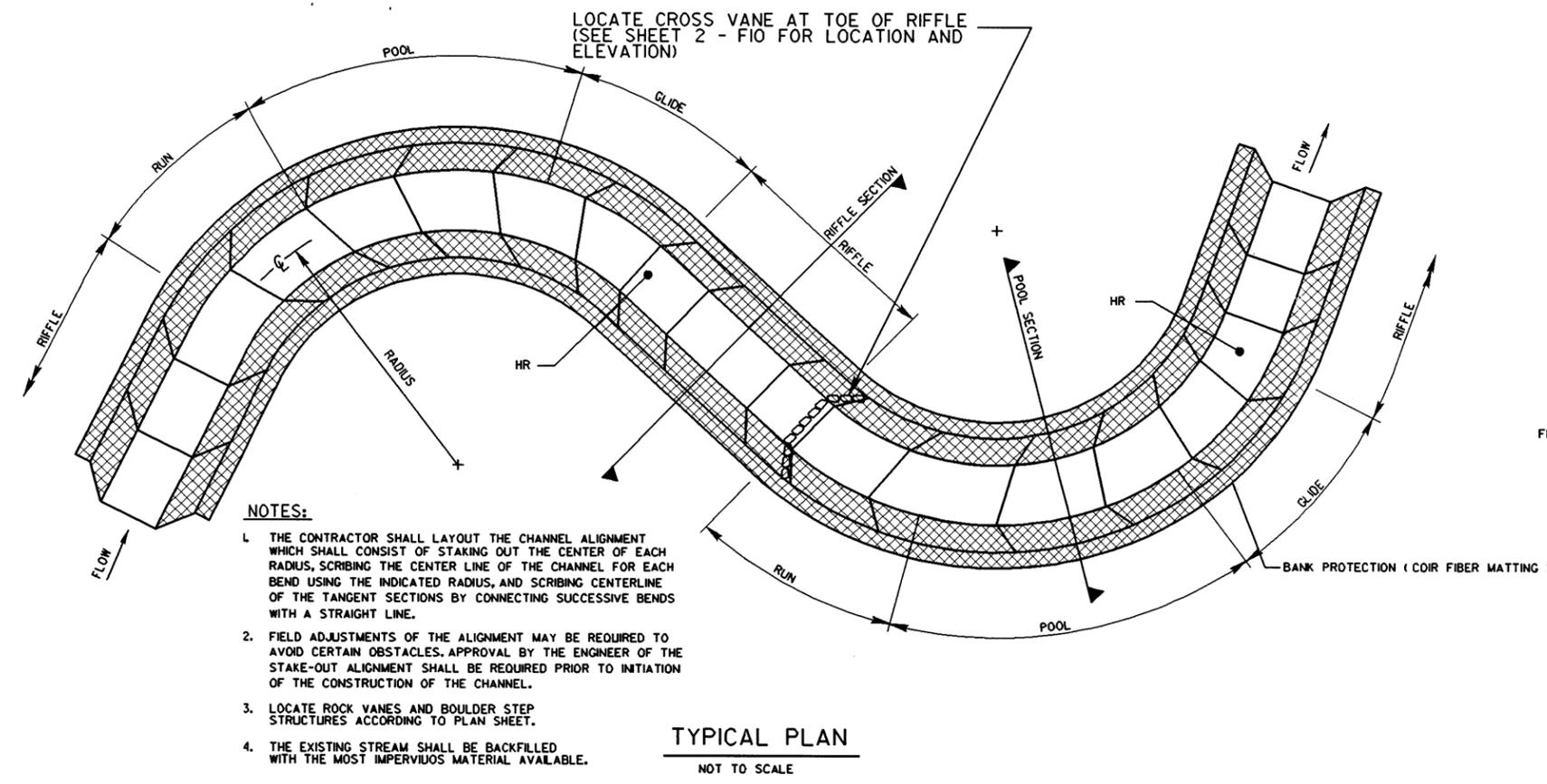
D₉₅: 71.0 mm

Bedrock 2 %

Pebble Count

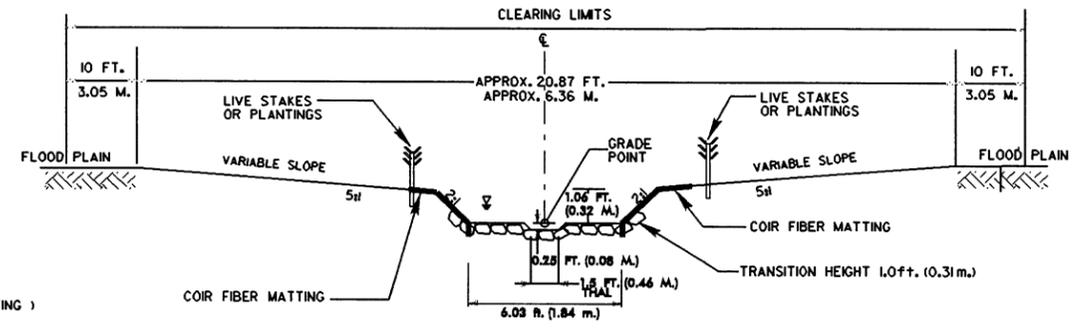


PROJECT REFERENCE NO. U-2527	SHEET NO. 2-F
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

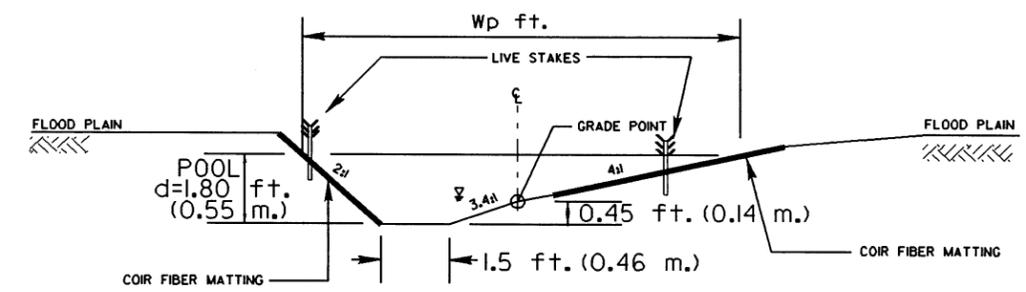


- NOTES:**
1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT WHICH SHALL CONSIST OF STAKING OUT THE CENTER OF EACH RADIUS, SCRIBING THE CENTER LINE OF THE CHANNEL FOR EACH BEND USING THE INDICATED RADIUS, AND SCRIBING CENTERLINE OF THE TANGENT SECTIONS BY CONNECTING SUCCESSIVE BENDS WITH A STRAIGHT LINE.
 2. FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO AVOID CERTAIN OBSTACLES. APPROVAL BY THE ENGINEER OF THE STAKE-OUT ALIGNMENT SHALL BE REQUIRED PRIOR TO INITIATION OF THE CONSTRUCTION OF THE CHANNEL.
 3. LOCATE ROCK VANES AND BOULDER STEP STRUCTURES ACCORDING TO PLAN SHEET.
 4. THE EXISTING STREAM SHALL BE BACKFILLED WITH THE MOST IMPERVIUOUS MATERIAL AVAILABLE.

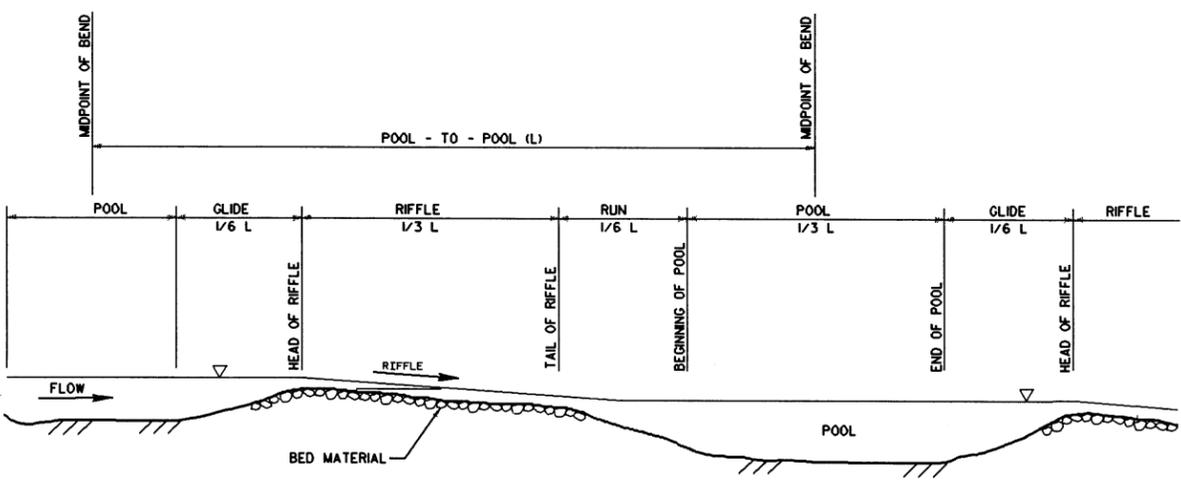
TYPICAL PLAN
NOT TO SCALE



TYPICAL RIFFLE SECTION
NOT TO SCALE



TYPICAL POOL SECTION
NOT TO SCALE



- NOTES:**
1. THE POOL TO POOL SPACING (L) SHALL BE MEASURED AS THE DISTANCE FROM THE MIDPOINT OF THE UPSTREAM BEND TO THE MIDPOINT OF THE DOWNSTREAM BEND.
 2. REFER TO MORPHOLOGICAL MEASUREMENT TABLE AND PLAN SHEET FOR DIMENSIONS. NOTE THAT POOL TO POOL SPACING VARIES.

TYPICAL PROFILE
NOT TO SCALE

MORPHOLOGICAL MEASUREMENT TABLE (ENGLISH TABLE)

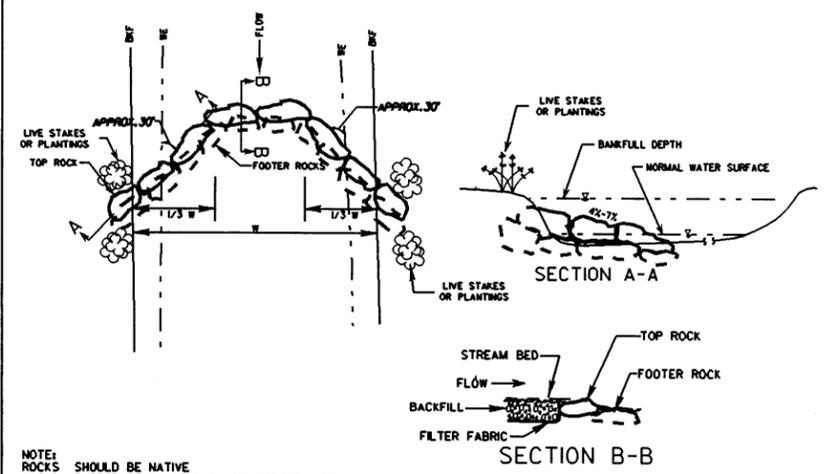
VARIABLES	EXISTING CHANNEL	PROPOSED REACH 1	PROPOSED REACH 2	REFERENCE REACH 3
1) STREAM TYPE	G4	B4c	NONE	B4c/1
2) DRAINAGE AREA	0.16sq.m	0.16sq.m		3.30sq.m
3) BANKFULL WIDTH	5.26ft	10.27ft		25.58ft
4) BANKFULL MEAN DEPTH	1.04ft	0.79ft		1.69ft
5) WIDTH/DEPTH RATIO	5.06	13.00		15.14
6) BANKFULL CROSS-SECTIONAL AREA	5.47sq.ft	8.18sq.ft		43.30sq.ft
7) BANKFULL MEAN VELOCITY	4.84fps	2.77fps		4.6fps
8) BANKFULL DISCHARGE Q _b	26.50cfs	27cfs		199cfs
9) BANKFULL MAX. DEPTH	1.47ft	1.06ft		3.0ft
10) WIDTH OF FLOODPRONE AREA	2.95ft	20.87ft		36.58ft
11) ENTRENCHMENT RATIO	0.56	2.03		1.43
12) MEANDER LENGTH	62.57ft	65.10ft		168.3ft
13) RATIO OF MEANDER LENGTH TO BANKFULL WIDTH	11.90	6.34		6.57
14) RADIUS OF CURVATURE	8.04ft	21ft		41.8ft
15) RATIO OF RADIUS OF CURVATURE TO BANKFULL WIDTH	1.53	2.04		1.61
16) MEAN WIDTH	26.02ft	26.51ft		43.7ft
17) MEANDER WIDTH RATIO	4.95	2.58		1.71
18) MEANDER WIDTH RATIO TO VALLEY LENGTH	1.35	1.18		1.07
19) VALLEY SLOPE	0.0196	0.0191		0.0088
20) AVERAGE SLOPE	0.0145	0.0162		0.0094
21) POOL SLOPE	0.0142	0.005		0.0004
22) RATIO OF POOL SLOPE TO AVERAGE SLOPE	.01	0.31		0.04
23) MAXIMUM POOL DEPTH	1.80ft	1.80ft		5.0ft
24) RATIO OF POOL DEPTH TO AVERAGE BANKFULL DEPTH	1.73	2.28		1.57
25) POOL WIDTH	3.29ft	12.02ft		25.84ft
26) RATIO OF POOL WIDTH TO BANKFULL WIDTH	.63	1.17		1.01
27) POOL TO POOL SPACING	23.83ft	36.30ft		62.4ft
28) RATIO OF POOL TO POOL SPACING TO BANKFULL WIDTH	4.53	3.53		2.44
29) RATIO OF LOWEST BANK HEIGHT TO BANKFULL HEIGHT (at max bankfull depth)	1.8	1.0		1.00

MORPHOLOGICAL MEASUREMENT TABLE (METRIC TABLE)

VARIABLES	EXISTING CHANNEL	PROPOSED REACH 1	PROPOSED REACH 2	REFERENCE REACH 3
1) STREAM TYPE	G4	B4c	NONE	B4c/1
2) DRAINAGE AREA	0.16sq.m	0.16sq.m		3.30sq.m
3) BANKFULL WIDTH	1.60 m	3.13 m		7.80 m
4) BANKFULL MEAN DEPTH	0.32 m	0.24 m		0.52 m
5) WIDTH/DEPTH RATIO	5.06	13.00		15.14
6) BANKFULL CROSS-SECTIONAL AREA	0.51sq.m	0.75sq.m		4.03sq.m
7) BANKFULL MEAN VELOCITY	1.48 mps	0.84 mps		1.40 mps
8) BANKFULL DISCHARGE Q _b	0.75cms	0.76cms		5.63cms
9) BANKFULL MAX. DEPTH	0.45 m	0.32 m		0.91 m
10) WIDTH OF FLOODPRONE AREA	0.90 m	6.36 m		11.5 m
11) ENTRENCHMENT RATIO	0.56	2.03		1.43
12) MEANDER LENGTH	19.07 m	19.84 m		51.30 m
13) RATIO OF MEANDER LENGTH TO BANKFULL WIDTH	11.90	6.34		6.57
14) RADIUS OF CURVATURE	2.45 m	6.40 m		12.55 m
15) RATIO OF RADIUS OF CURVATURE TO BANKFULL WIDTH	1.53	2.04		1.61
16) MEAN WIDTH	7.93 m	8.08 m		13.32 m
17) MEANDER WIDTH RATIO	4.95	2.58		1.71
18) MEANDER WIDTH RATIO TO VALLEY LENGTH	1.35	1.18		1.07
19) VALLEY SLOPE	0.0196	0.0191		0.0088
20) AVERAGE SLOPE	0.0145	0.0162		0.0094
21) POOL SLOPE	0.0142	0.005		0.0004
22) RATIO OF POOL SLOPE TO AVERAGE SLOPE	.01	0.31		0.04
23) MAXIMUM POOL DEPTH	0.55 m	0.55 m		1.52 m
24) RATIO OF POOL DEPTH TO AVERAGE BANKFULL DEPTH	1.73	2.28		1.57
25) POOL WIDTH	1.00 m	3.66 m		7.88 m
26) RATIO OF POOL WIDTH TO BANKFULL WIDTH	.63	1.17		1.01
27) POOL TO POOL SPACING	7.26 m	11.06 m		19.02 m
28) RATIO OF POOL TO POOL SPACING TO BANKFULL WIDTH	4.53	3.53		2.44
29) RATIO OF LOWEST BANK HEIGHT TO BANKFULL HEIGHT (at max bankfull depth)	1.8	1.0		1.00

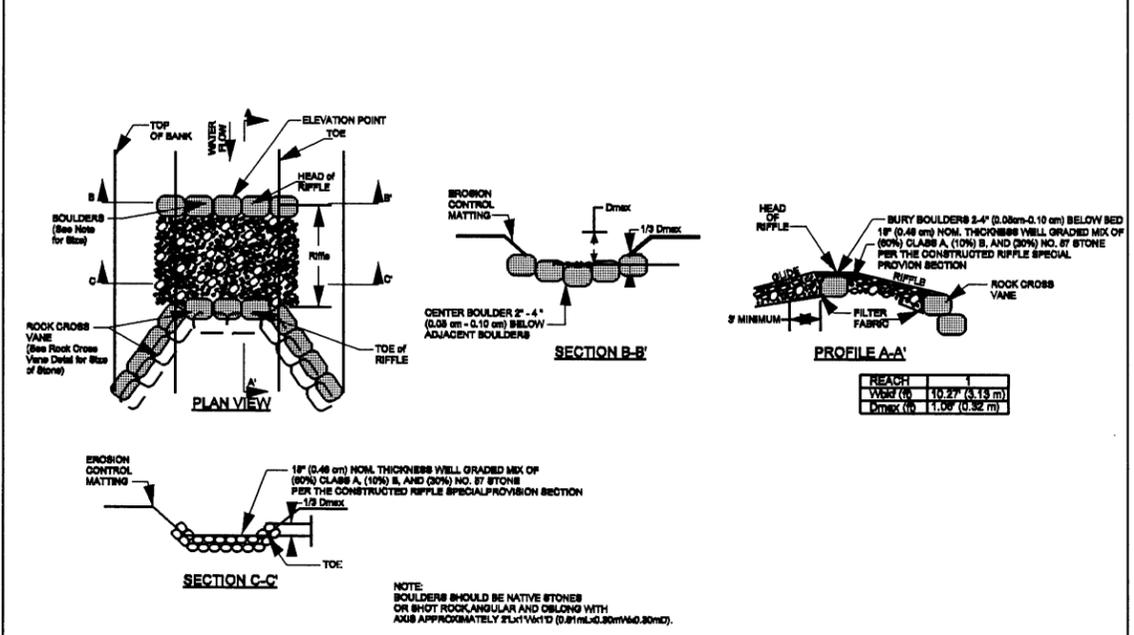
ROCK CROSS VANE

(NOT TO SCALE)



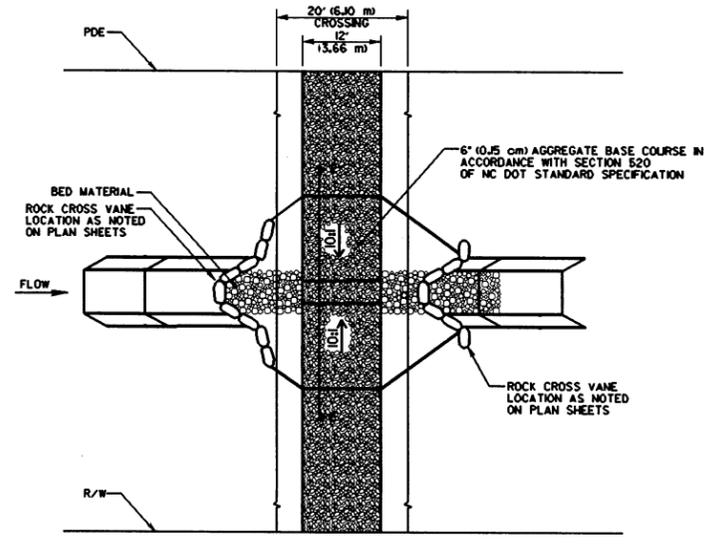
NOTE:
ROCKS SHOULD BE NATIVE
STONE OR SHOT ROCK, ANGULAR AND OBLONG WITH
AXIS APPROXIMATELY 3'Lx2'WxD (0.9mLx0.6mWx0.30mD).

CONSTRUCTED RIFFLE

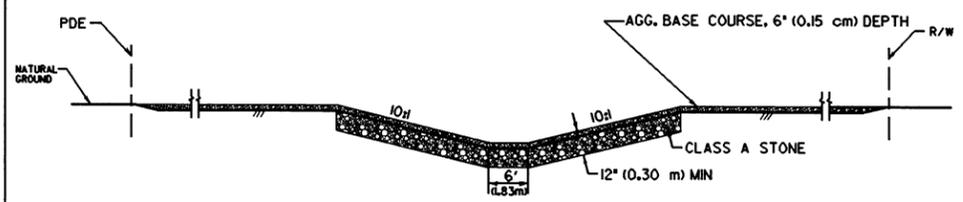


NOTE:
BOULDERS SHOULD BE NATIVE STONES
OR SHOT ROCK, ANGULAR AND OBLONG WITH
AXIS APPROXIMATELY 3'Lx2'WxD (0.9mLx0.30mWx0.30mD).

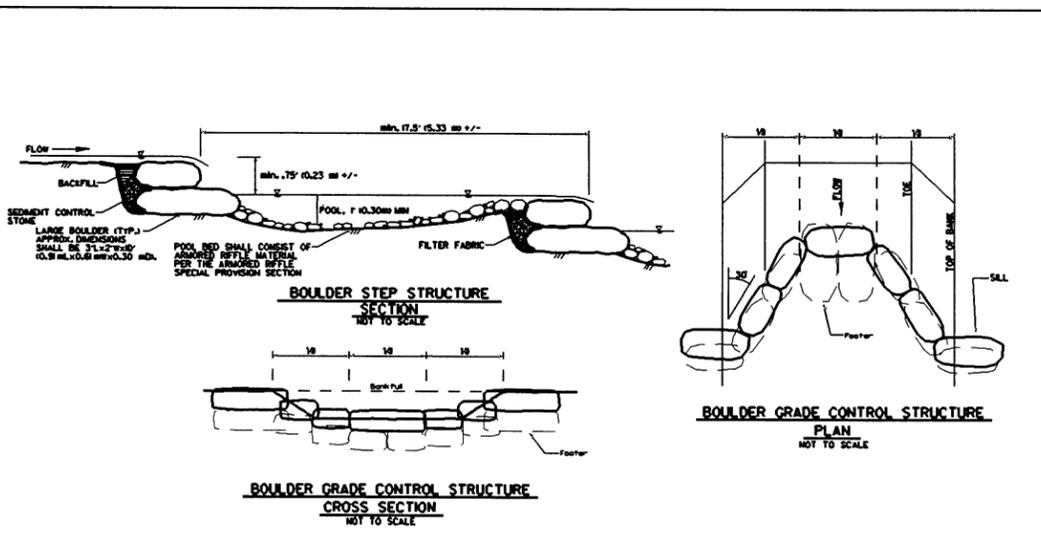
CONSTRUCTED RIFFLE



STREAM CROSSING - TYPE II
PLAN VIEW
NOT TO SCALE



STREAM CROSSING - TYPE II
SECTION E-E
NOT TO SCALE



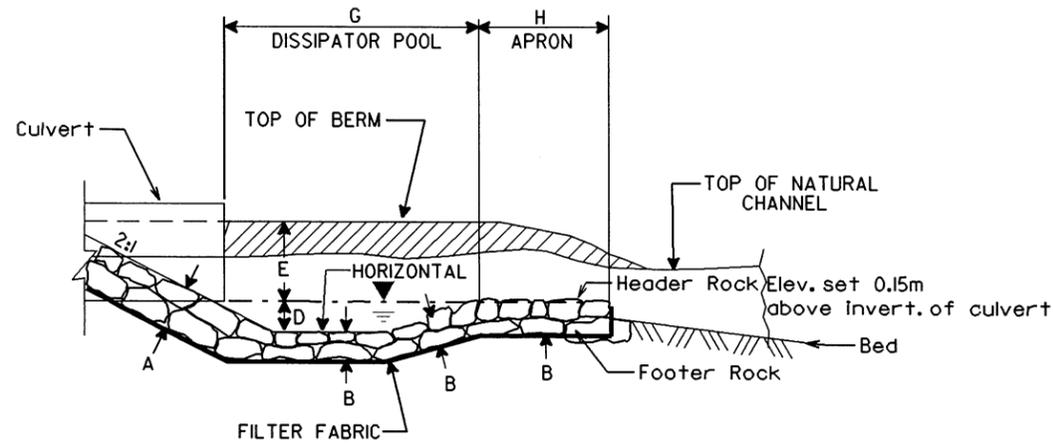
DISSIPATOR BASIN

ROCK CROSS VANE

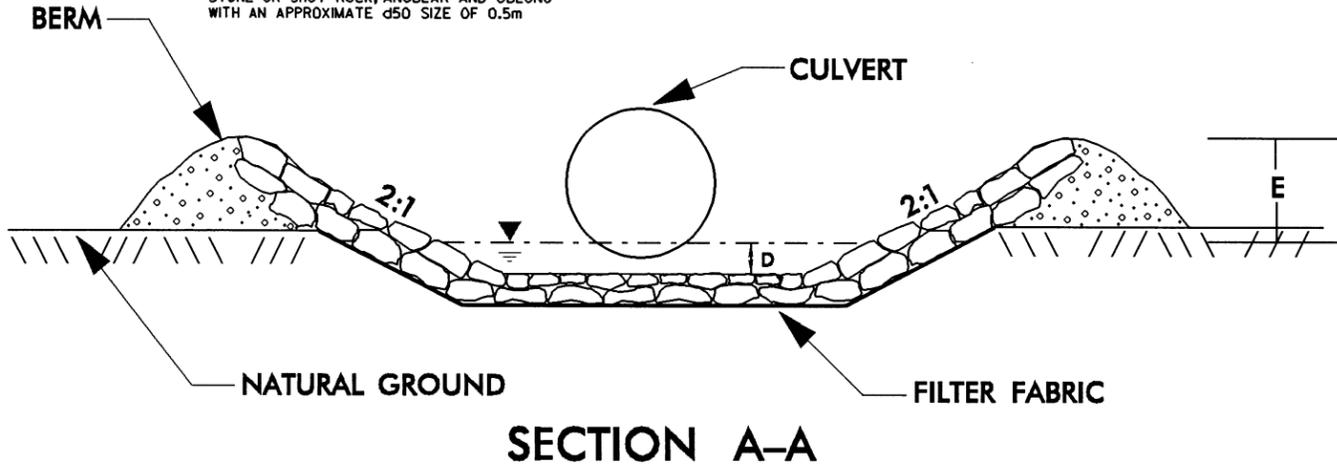
METRIC

PROJECT REFERENCE NO. U-2527	SHEET NO. 2-F2
HIGHWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

SECTION C-C



NOTE: DISSIPATOR ROCKS SHOULD BE NATIVE STONE OR SHOT ROCK, ANGULAR AND OBLONG WITH AN APPROXIMATE d50 SIZE OF 0.5m

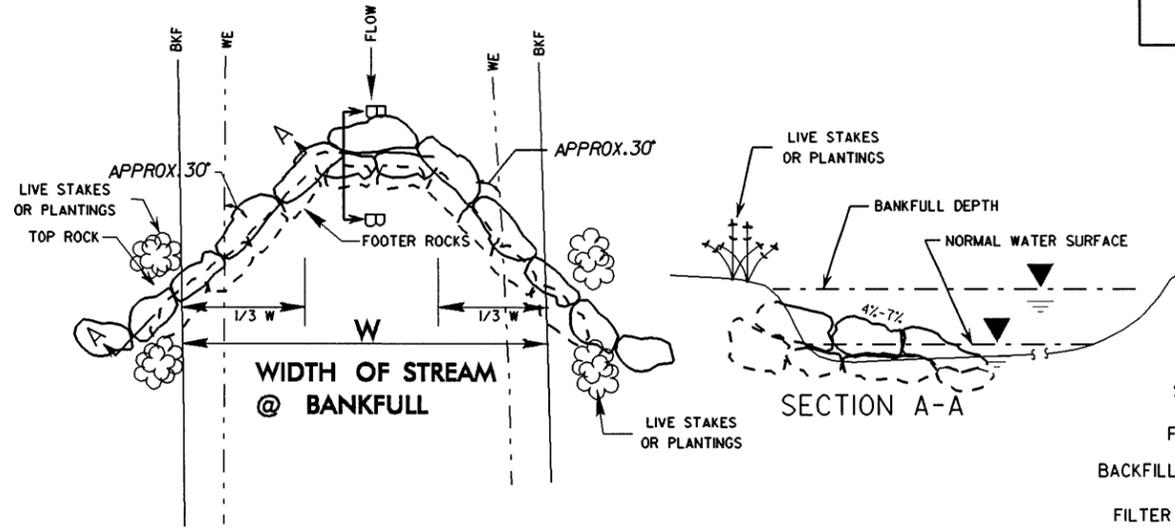


DIM.	RIP RAP BASIN #							
	1	2	3	4	5	6	7	8
A	1.0							
B	1.0							
C	—							
D	1.0							
E	1.0							
F	—							
G	5.08							
H	1.52							

BASIN #	LOCATION (AT OUTLET)
1	45+96.576 RT. (1200mm)
2	
3	
4	
5	
6	
7	
8	

ALL DIMENSIONS APPROXIMATE IN m

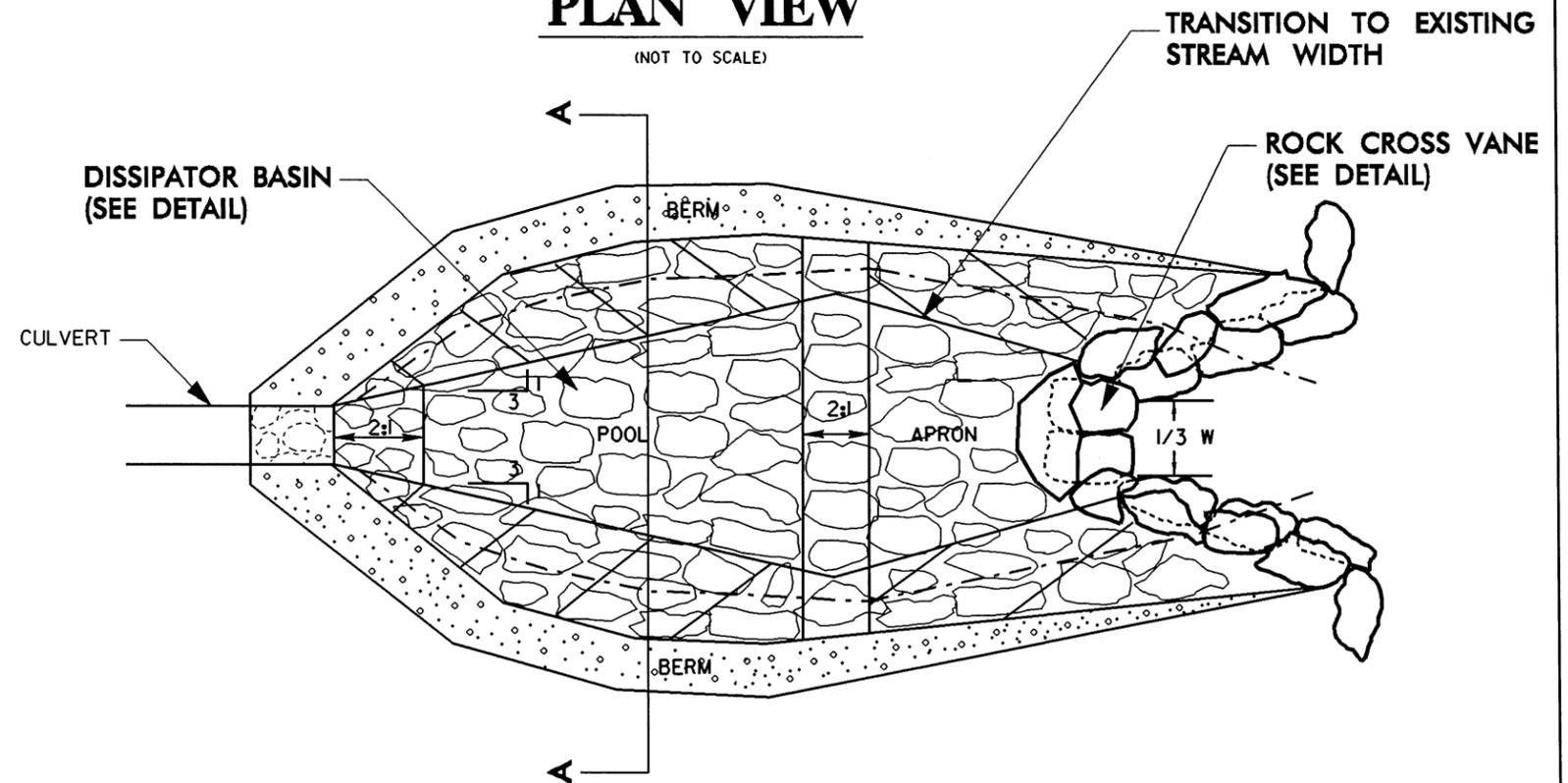
(NOT TO SCALE)



NOTE: CROSS VANE ROCKS SHOULD BE NATIVE STONE OR SHOT ROCK, ANGULAR AND OBLONG WITH LONG AXIS APPROXIMATELY 3'Lx2'Wx1'D IN LENGTH

PLAN VIEW

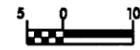
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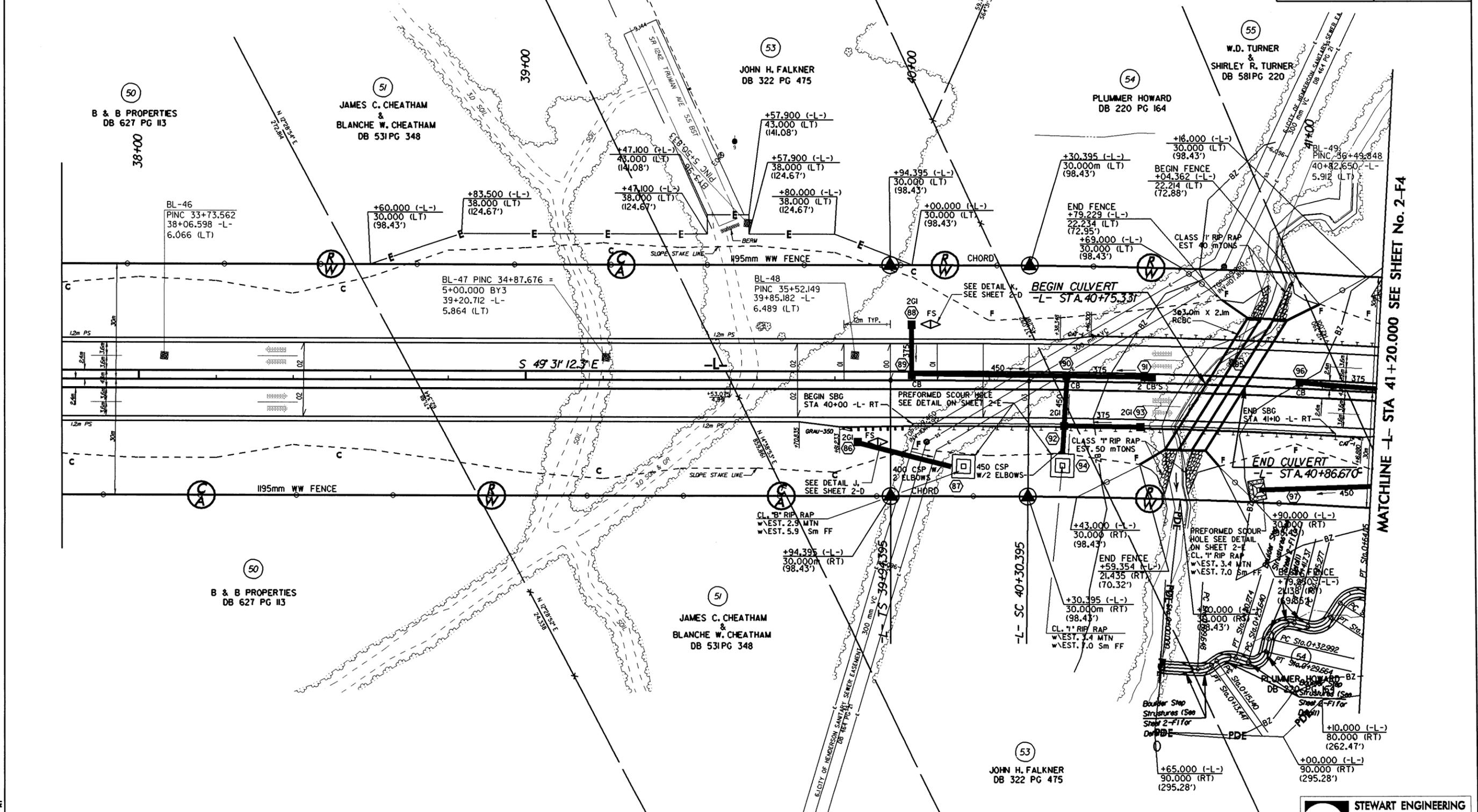


DETAIL OF NATURAL ROCK ENERGY DISSIPATOR BASIN (NOT TO SCALE)

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS
RALEIGH, N.C.

REVISIONS

	PROJECT REFERENCE NO.	SHEET NO.
	U-2527	2-F3
	R/W SHEET NO.	
	ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.		
R/W REV.		



SEE SHEETS 2-F6 THROUGH 2-F8 FOR STREAM ALIGNMENT

SEE SHEETS 2-F9 AND 2-F10 FOR STREAM PROFILE

SEE SHEETS 22 & 23 FOR -L- PROFILE

SEE SHEETS C-5 THRU C-9 FOR CULVERT

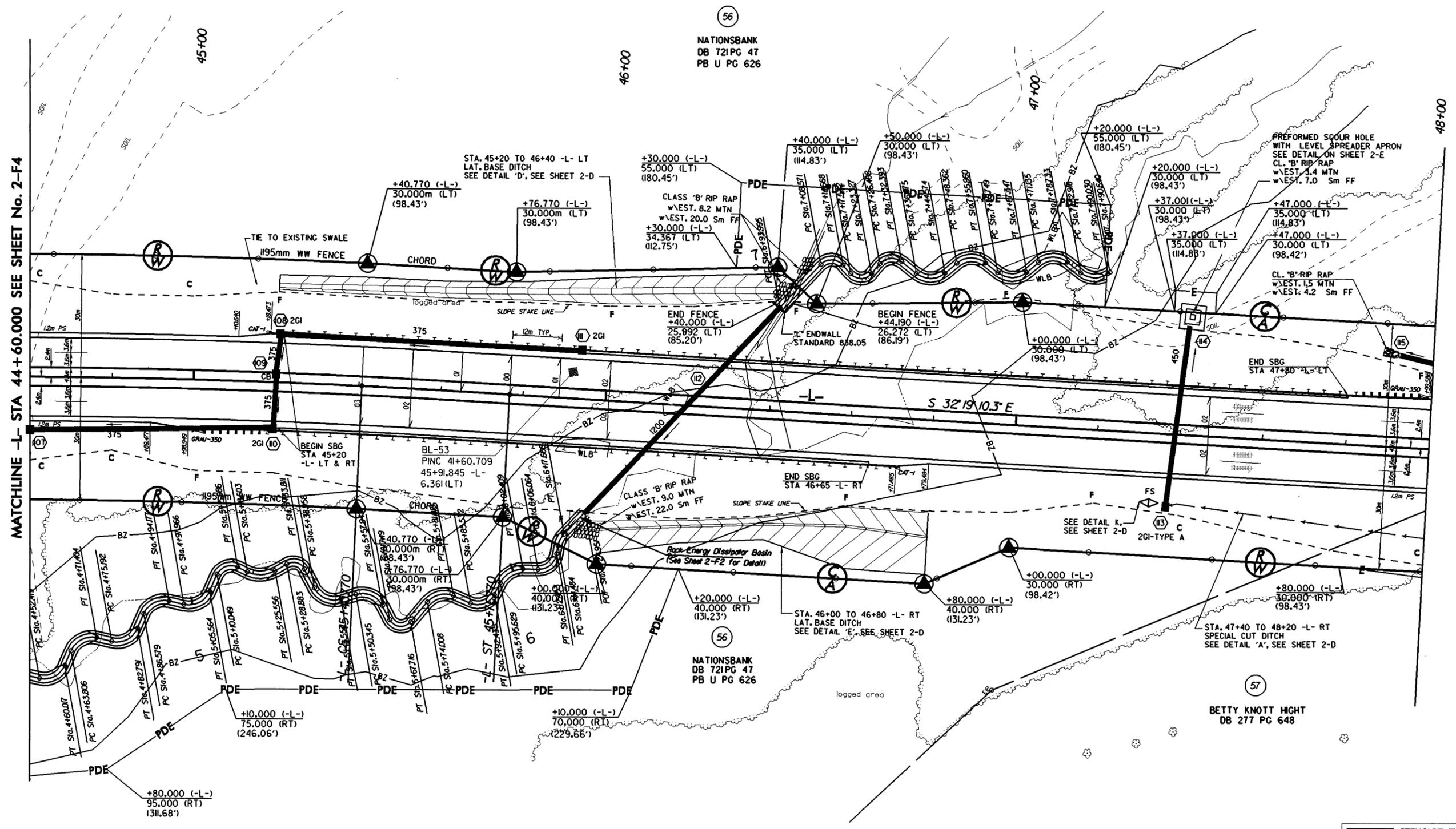
MATCHLINE -L- STA 41+20.000 SEE SHEET No. 2-F4

STEWART ENGINEERING
 STRUCTURAL
 TRANSPORTATION
 CIVIL
 P.O. BOX 22054 RESEARCH TRIANGLE PARK, NC 27709
 TEL. 919.280.8750 FAX 919.280.8752

REVISIONS	

	PROJECT REFERENCE NO.	SHEET NO.
	U-2527	2-F5
	R/W SHEET NO.	
	ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.		
R/W REV.		

NC GRID NAD 83



MATCHLINE -L- STA 44+60.000 SEE SHEET No. 2-F4

SEE SHEETS 2-F6 THROUGH 2-F8 FOR STREAM ALIGNMENT

SEE SHEETS 2-F9 AND 2-F10 FOR STREAM PROFILE

SEE SHEETS 23 & 24 FOR -L- PROFILE

STEWART ENGINEERING
 STRUCTURAL
 TRANSPORTATION
 CIVIL
 P.O. BOX 12054 RESEARCH TRIANGLE PARK, NC 27709
 TEL 919.380.8750 FAX 919.380.8782

25.11.2014 10:00 AM C:\Users\jw056178\OneDrive\2527-2-F5.dwg

PROPOSED STREAM CENTER LINE TRAVERSE

 CONST. REV. R/W REV.	PROJECT REFERENCE NO. U-2527	SHEET NO. 2-F6
	R/W SHEET NO.	
	ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

1 Describe Chain FNLSTM

Chain FNLSTM contains:
 50004 CUR FNLSTM-1 CUR FNLSTM-2 CUR FNLSTM-3 CUR FNLSTM-4 CUR FNLSTM-5 CUR FNLSTM-6 CUR FNLSTM-7 CUR FNLSTM-8 CUR FNLSTM-9 CUR FNLSTM-10 CUR FNLSTM-11 CUR FNLSTM-12 CUR FNLSTM-13 CUR FNLSTM-14 CUR FNLSTM-15 CUR FNLSTM-16 CUR FNLSTM-17 CUR FNLSTM-18 CUR FNLSTM-19 CUR FNLSTM-20 CUR FNLSTM-21 CUR FNLSTM-22 CUR FNLSTM-23 CUR FNLSTM-24 CUR FNLSTM-25 CUR FNLSTM-26 CUR FNLSTM-27 CUR FNLSTM-28 CUR FNLSTM-29 CUR FNLSTM-30 CUR FNLSTM-31 CUR FNLSTM-32 CUR FNLSTM-33 CUR FNLSTM-34 CUR FNLSTM-35 CUR FNLSTM-36 CUR FNLSTM-37 CUR FNLSTM-38 CUR FNLSTM-39 CUR FNLSTM-40 CUR FNLSTM-41 CUR FNLSTM-42 CUR FNLSTM-43 CUR FNLSTM-44 CUR FNLSTM-45 CUR FNLSTM-46 CUR FNLSTM-47 CUR FNLSTM-48 CUR FNLSTM-49 CUR FNLSTM-50 CUR FNLSTM-51 CUR FNLSTM-52 CUR FNLSTM-53 CUR FNLSTM-54 CUR FNLSTM-55 CUR FNLSTM-56 50005 F-0005 CUR FNLSTM-57 CUR FNLSTM-58 CUR FNLSTM-59 CUR FNLSTM-60 CUR FNLSTM-61 CUR FNLSTM-62 CUR FNLSTM-63 CUR FNLSTM-64 50007

Beginning chain FNLSTM description

Point 50004 N 283,226.0798 E 660,261.9368 Sta 0+00.00

Course from 50004 to PC FNLSTM-1 S 45° 59' 52.22" E Dist 9.6476

Curve Data	
P.I. Station	0+11.63 N 283,218.0027 E 660,270.3003
Delta	39° 40' 49.00" (LT)
Degree	1044° 23' 59.71"
Tangent	1.3794
Length	3.7993
Radius	5.4860
External	1.3642
Long Chord	3.7239
Mid. Ord.	0.3256
P.C. Station	0+09.65 N 283,219.3777 E 660,268.8765
P.T. Station	0+13.45 N 283,217.8535 E 660,272.2741
C.C. Station	0+11.55 N 283,223.3239 E 660,272.6875
Back	S 45° 59' 52.22" E
Ahead	S 85° 40' 41.22" E
Chord Bear	S 65° 50' 16.72" E

Course from PT FNLSTM-1 to PC FNLSTM-2 S 85° 40' 41.22" E Dist 1.6931

Curve Data	
P.I. Station	0+17.91 N 283,217.5170 E 660,276.7267
Delta	53° 37' 03.07" (RT)
Degree	1044° 23' 59.71"
Tangent	2.7722
Length	5.1338
Radius	5.4860
External	0.6507
Long Chord	4.3485
Mid. Ord.	0.5897
P.C. Station	0+15.14 N 283,217.7259 E 660,273.9623
P.T. Station	0+20.27 N 283,215.1676 E 660,278.982
C.C. Station	0+17.70 N 283,212.2555 E 660,273.5489
Back	S 85° 40' 41.22" E
Ahead	S 32° 03' 38.15" E
Chord Bear	S 58° 52' 09.68" E

Course from PT FNLSTM-2 to PC FNLSTM-3 S 32° 03' 38.15" E Dist 3.3659

Curve Data	
P.I. Station	0+27.59 N 283,208.9693 E 660,282.0805
Delta	94° 21' 54.18" (LT)
Degree	1566° 18' 51.72"
Tangent	3.9479
Length	6.0247
Radius	3.6580
External	1.7241
Long Chord	5.3665
Mid. Ord.	1.1718
P.C. Station	0+23.64 N 283,212.3150 E 660,279.9849
P.T. Station	0+29.66 N 283,211.3134 E 660,285.2570
C.C. Station	0+26.65 N 283,214.2568 E 660,283.0850
Back	S 32° 03' 38.15" E
Ahead	N 53° 34' 27.67" E
Chord Bear	S 79° 14' 35.24" E

Course from PT FNLSTM-3 to PC FNLSTM-4 N 53° 34' 27.67" E Dist 3.3274

Curve Data	
P.I. Station	0+38.61 N 283,216.6233 E 660,292.4524
Delta	91° 19' 57.82" (RT)
Degree	1044° 23' 59.71"
Tangent	5.6151
Length	8.7450
Radius	5.4860
External	2.3642
Long Chord	7.8481
Mid. Ord.	1.6522
P.C. Station	0+32.99 N 283,213.2892 E 660,287.9344
P.T. Station	0+41.74 N 283,212.0289 E 660,295.6806
C.C. Station	0+37.36 N 283,208.8750 E 660,291.1918
Back	N 53° 34' 27.67" E
Ahead	S 35° 05' 34.50" E
Chord Bear	S 80° 45' 33.42" E

Course from PT FNLSTM-4 to PC FNLSTM-5 S 35° 05' 34.50" E Dist 3.5402

Curve Data	
P.I. Station	0+49.24 N 283,205.8916 E 660,299.9928
Delta	71° 39' 14.23" (LT)
Degree	1044° 23' 59.71"
Tangent	3.9606
Length	6.8608
Radius	5.4860
External	1.2803
Long Chord	6.4223
Mid. Ord.	1.0380
P.C. Station	0+45.28 N 283,209.1322 E 660,297.7159
P.T. Station	0+52.14 N 283,207.0238 E 660,303.7854
C.C. Station	0+48.71 N 283,212.2861 E 660,302.2047
Back	S 35° 05' 34.50" E
Ahead	S 70° 55' 11.62" E
Chord Bear	S 70° 55' 11.62" E

Course from PT FNLSTM-5 to PC FNLSTM-6 N 73° 15' 11.27" E Dist 4.3788

Curve Data	
P.I. Station	0+61.07 N 283,209.6058 E 660,312.3364
Delta	79° 21' 16.42" (RT)
Degree	1044° 23' 59.71"
Tangent	4.5509
Length	7.9981
Radius	5.4860
External	1.6419
Long Chord	7.0052
Mid. Ord.	1.2637
P.C. Station	0+55.52 N 283,208.2945 E 660,307.9785
P.T. Station	0+64.11 N 283,205.5652 E 660,314.4301
C.C. Station	0+60.81 N 283,203.0412 E 660,309.5593
Back	N 73° 15' 11.27" E
Ahead	S 27° 23' 32.31" E
Chord Bear	S 67° 04' 10.52" E

Course from PT FNLSTM-6 to PC FNLSTM-7 S 27° 23' 32.31" E Dist 3.7886

Curve Data	
P.I. Station	0+72.45 N 283,198.1607 E 660,318.2670
Delta	79° 21' 19.05" (LT)
Degree	1044° 23' 59.71"
Tangent	4.5910
Length	7.5982
Radius	5.4860
External	1.6419
Long Chord	7.0052
Mid. Ord.	1.2637
P.C. Station	0+67.90 N 283,202.2014 E 660,316.1732
P.T. Station	0+75.50 N 283,199.4721 E 660,322.6249
C.C. Station	0+71.70 N 283,204.7254 E 660,321.0441
Back	S 27° 23' 32.31" E
Ahead	N 73° 15' 08.64" E
Chord Bear	S 67° 04' 11.84" E

Course from PT FNLSTM-7 to PC FNLSTM-8 N 73° 15' 08.64" E Dist 3.6996

Curve Data	
P.I. Station	0+83.84 N 283,201.8751 E 660,330.6104
Delta	113° 23' 38.17" (RT)
Degree	1879° 46' 58.05"
Tangent	4.6258
Length	6.0323
Radius	3.0480
External	2.5032
Long Chord	5.0499
Mid. Ord.	1.3744
P.C. Station	0+79.20 N 283,200.5382 E 660,326.1676
P.T. Station	0+87.23 N 283,197.6195 E 660,330.0734
C.C. Station	0+83.21 N 283,197.6195 E 660,327.0459
Back	N 73° 15' 08.64" E
Ahead	S 6° 38' 46.81" W
Chord Bear	S 50° 03' 02.28" E

Course from PT FNLSTM-8 to PC FNLSTM-9 S 6° 38' 46.81" W Dist 3.4473

Curve Data	
P.I. Station	0+93.05 N 283,189.5051 E 660,329.1690
Delta	59° 37' 53.35" (LT)
Degree	751° 54' 47.22"
Tangent	4.3669
Length	7.9507
Radius	6.2000
External	1.1626
Long Chord	7.5775
Mid. Ord.	1.0087
P.C. Station	0+88.68 N 283,193.8426 E 660,329.6744
P.T. Station	0+96.51 N 283,186.8762 E 660,332.6539
C.C. Station	0+92.59 N 283,192.9606 E 660,337.2432
Back	S 6° 38' 46.81" W
Ahead	S 26° 22' 08.60" W
Chord Bear	S 23° 10' 11.16" E

Course from PT FNLSTM-9 to PC FNLSTM-10 S 52° 59' 09.14" E Dist 3.9723

Curve Data	
P.I. Station	1+05.13 N 283,181.7451 E 660,339.4616
Delta	79° 21' 17.74" (RT)
Degree	1044° 23' 59.71"
Tangent	4.5509
Length	7.5982
Radius	5.4860
External	1.6419
Long Chord	7.0052
Mid. Ord.	1.2637
P.C. Station	1+00.58 N 283,184.4848 E 660,335.8277
P.T. Station	1+08.29 N 283,177.6676 E 660,337.4403
C.C. Station	1+04.43 N 283,180.1043 E 660,332.5251
Back	S 52° 59' 09.14" E
Ahead	S 26° 22' 08.60" W
Chord Bear	S 13° 18' 30.27" E

Course from PT FNLSTM-10 to PC FNLSTM-11 S 26° 22' 08.60" W Dist 3.5692

Curve Data	
P.I. Station	1+16.52 N 283,170.1959 E 660,333.7363
Delta	92° 25' 51.64" (LT)
Degree	1253° 11' 18.70"
Tangent	4.7702
Length	7.3751
Radius	4.1220
External	2.0354
Long Chord	6.6015
Mid. Ord.	1.4084
P.C. Station	1+11.75 N 283,174.4698 E 660,335.8550
P.T. Station	1+19.13 N 283,168.2604 E 660,338.0962
C.C. Station	1+13.44 N 283,172.4391 E 660,339.9513
Back	S 26° 22' 08.60" W
Ahead	S 66° 03' 43.03" E
Chord Bear	S 19° 50' 47.22" E

Course from PT FNLSTM-11 to PC FNLSTM-12 S 66° 03' 43.03" E Dist 3.6893

Curve Data	
P.I. Station	1+26.57 N 283,165.2384 E 660,344.9035
Delta	63° 18' 50.78" (RT)
Degree	939° 53' 29.03"
Tangent	3.7587
Length	6.7363
Radius	6.0960
External	1.0696
Long Chord	6.3988
Mid. Ord.	0.9771
P.C. Station	1+22.82 N 283,166.7635 E 660,341.4681
P.T. Station	1+29.95 N 283,161.4841 E 660,345.0837
C.C. Station	1+26.37 N 283,161.1918 E 660,338.9947
Back	S 66° 03' 43.03" E
Ahead	S 2° 44' 52.25" E
Chord Bear	S 34° 24' 17.64" E

Course from PT FNLSTM-12 to PC FNLSTM-13 S 2° 44' 52.25" E Dist 4.5808

Curve Data	
P.I. Station	1+38.68 N 283,152.3628 E 660,345.5215
Delta	79° 21' 20.14" (LT)
Degree	1044° 23' 59.71"
Tangent	4.5509
Length	7.5982
Radius	5.4860
External	1.6419
Long Chord	7.0052
Mid. Ord.	1.2637
P.C. Station	1+34.13 N 283,156.8086 E 660,345.3033
P.T. Station	1+41.73 N 283,151.7376 E 660,350.0293
C.C. Station	1+37.93 N 283,157.1716 E 660,350.7830
Back	S 2° 44' 52.25" E
Ahead	S 82° 06' 12.39" E
Chord Bear	S 42° 25' 32.32" E

Course from PT FNLSTM-13 to PC FNLSTM-14 S 82° 06' 12.39" E Dist 4.0731

Curve Data	
P.I. Station	1+40.07 N 283,150.5919 E 660,358.2895
Delta	86° 02' 11.71" (RT)
Degree	1253° 11' 18.70"
Tangent	4.2662
Length	6.8608
Radius	4.5720
External	1.6813
Long Chord	6.2383
Mid. Ord.	1.2292
P.C. Station	1+45.80 N 283,151.1780 E 660,354.0638
P.T. Station	1+52.67 N 283,146.3357 E 660,357.9969
C.C. Station	1+49.23 N 283,146.6494 E 660,353.4357
Back	S 82° 06' 12.39" E
Ahead	S 3° 55' 59.32" W
Chord Bear	S 39° 05' 06.53" E

Course from PT FNLSTM-14 to PC FNLSTM-15 S 3° 55' 59.32" W Dist 4.0108

Curve Data	
P.I. Station	1+61.05 N 283,137.9779 E 660,357.4223
Delta	71° 13' 51.19" (LT)
Degree	939° 53' 29.03"
Tangent	4.3668
Length	7.5786
Radius	6.0960
External	1.4027
Long Chord	7.0939
Mid. Ord.	1.1403
P.C. Station	1+56.68 N 283,142.3344 E 660,357.7218
P.T. Station	1+64.26 N 283,136.2926 E 660,361.4507
C.C. Station	1+60.47 N 283,141.9163 E 660,363.8034
Back	S 3° 55' 59.32" W
Ahead	S 67° 17' 51.87" E
Chord Bear	S 31° 40' 56.27" E

Course from PT FNLSTM-15 to PC FNLSTM-16 S 67° 17' 51.87" E Dist 3.9744

Curve Data	
P.I. Station	1+72.80 N 283,132.9973 E 660,369.3275
Delta	79° 30' 53.85" (RT)
Degree	1044° 23' 59.71"
Tangent	4.5639
Length	7.6134
Radius	5.4860
External	1.6502

	PROJECT REFERENCE NO.	SHEET NO.
	U-2527	2-F7
	R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER	
CONST. REV.		
R/W REV.		

PROPOSED STREAM CENTER LINE TRAVERSE

Curve Data	Curve Data	Curve Data	Curve Data	Curve Data	Curve Data		
Curve FNLSTM-27 P.I. Station = 2498.10 N 283.032.4159 E 660.412.4680 Delta = 79° 30' 52.53" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 2433.53 N 283.036.8764 E 660.413.4338 P.T. Station = 2461.15 N 283.035.7154 E 660.416.6782 C.C. = 2447.34 N 283.036.2959 E 660.415.0560 Back = S 12° 13' 03.14" W Ahead = S 67° 17' 49.40" E Chord Bear = S 27° 32' 23.13" E Course from PT FNLSTM-27 to PC FNLSTM-28 S 67° 17' 49.40" E D1st 4.2016	Curve FNLSTM-34 P.I. Station = 3478.51 N 282.985.9713 E 660.467.0825 Delta = 79° 21' 15.68" (RT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 3413.36 N 282.986.3264 E 660.462.5455 P.T. Station = 3461.56 N 282.981.4468 E 660.467.5717 C.C. = 3437.46 N 282.984.1175 E 660.464.8195 Back = S 85° 31' 29.48" E Ahead = S 6° 10' 13.80" E Chord Bear = S 45° 50' 51.64" E Course from PT FNLSTM-34 to PC FNLSTM-35 S 6° 10' 13.80" E D1st 3.7883	Curve FNLSTM-41 P.I. Station = 4456.97 N 282.937.8374 E 660.515.7638 Delta = 79° 21' 26.87" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5984 Radius = 5.4860 External = 1.6420 Long Chord = 7.0054 Mid. Ord. = 1.2638 P.C. Station = 4402.42 N 282.942.0321 E 660.514.0183 P.T. Station = 4454.02 N 282.938.7919 E 660.520.2324 C.C. = 4428.22 N 282.940.1603 E 660.519.0747 Back = S 22° 49' 33.69" E Ahead = N 77° 48' 59.44" E Chord Bear = S 62° 30' 17.12" E Course from PT FNLSTM-41 to PC FNLSTM-42 N 77° 48' 59.44" E D1st 3.7883	Curve FNLSTM-48 P.I. Station = 532.07 N 282.907.9152 E 660.574.6467 Delta = 92° 38' 09.43" (RT) Degree = 1879° 46' 58.05" Tangent = 3.1916 Length = 4.9200 Radius = 3.0480 External = 1.3652 Long Chord = 4.4085 Mid. Ord. = 0.9429 P.C. Station = 542.81 N 282.909.2122 E 660.571.7306 P.T. Station = 543.81 N 282.905.0618 E 660.573.2170 C.C. = 543.01 N 282.906.4272 E 660.570.4919 Back = S 66° 01' 19.64" E Ahead = S 26° 36' 49.79" W Chord Bear = S 19° 42' 14.93" E Course from PT FNLSTM-48 to PC FNLSTM-49 S 26° 36' 49.79" W D1st 5.1478	Curve FNLSTM-28 P.I. Station = 3409.49 N 283.027.4352 E 660.424.3731 Delta = 61° 07' 35.98" (RT) Degree = 817° 20' 36.61" Tangent = 4.1396 Length = 7.4787 Radius = 7.0100 External = 1.1311 Long Chord = 7.1290 Mid. Ord. = 0.9739 P.C. Station = 3405.35 N 283.029.0329 E 660.420.5542 P.T. Station = 3412.83 N 283.023.3195 E 660.424.8181 C.C. = 3409.15 N 283.022.5660 E 660.417.8487 Back = S 67° 17' 49.40" E Ahead = S 6° 10' 13.22" E Chord Bear = S 36° 44' 01.41" E Course from PT FNLSTM-28 to PC FNLSTM-29 S 6° 10' 13.22" E D1st 4.1996	Curve FNLSTM-35 P.I. Station = 3489.80 N 282.973.1559 E 660.468.4681 Delta = 79° 21' 15.25" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 3424.35 N 282.977.6804 E 660.467.9789 P.T. Station = 3461.56 N 282.972.8008 E 660.473.0051 C.C. = 3443.46 N 282.974.2701 E 660.470.5131 Back = S 6° 10' 13.80" E Ahead = S 85° 31' 29.05" E Chord Bear = S 45° 50' 51.43" E Course from PT FNLSTM-35 to PC FNLSTM-36 S 85° 31' 29.05" E D1st 3.7885	Curve FNLSTM-42 P.I. Station = 4468.36 N 282.940.5579 E 660.528.3840 Delta = 79° 21' 23.97" (RT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5983 Radius = 5.4860 External = 1.6420 Long Chord = 7.0054 Mid. Ord. = 1.2637 P.C. Station = 4414.02 N 282.939.5974 E 660.523.9354 P.T. Station = 4465.02 N 282.936.3632 E 660.530.1495 C.C. = 4439.52 N 282.934.2350 E 660.525.0932 Back = N 77° 48' 59.44" E Ahead = S 22° 49' 36.59" E Chord Bear = S 62° 30' 18.58" E Course from PT FNLSTM-42 to PC FNLSTM-43 S 22° 49' 36.59" E D1st 3.7884	Curve FNLSTM-45 P.I. Station = 5443.51 N 282.896.3906 E 660.568.8722 Delta = 79° 21' 18.83" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5982 Radius = 5.4860 External = 1.6419 Long Chord = 7.0053 Mid. Ord. = 1.2637 P.C. Station = 5438.96 N 282.900.4594 E 660.570.9109 P.T. Station = 5446.56 N 282.894.0018 E 660.572.4944 C.C. = 5443.23 N 282.898.0018 E 660.575.8156 Back = S 26° 36' 49.79" W Ahead = S 52° 44' 30.15" E Chord Bear = S 13° 03' 50.18" E Course from PT FNLSTM-45 to PC FNLSTM-46 S 52° 44' 30.15" E D1st 3.7883
Curve FNLSTM-29 P.I. Station = 3421.58 N 283.014.6197 E 660.425.7587 Delta = 79° 21' 15.63" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 3417.03 N 283.019.1442 E 660.425.2695 P.T. Station = 3424.63 N 283.014.2646 E 660.430.2957 C.C. = 3420.83 N 283.019.7339 E 660.430.7237 Back = S 6° 10' 13.22" E Ahead = S 85° 31' 29.05" E Chord Bear = S 45° 50' 51.24" E Course from PT FNLSTM-29 to PC FNLSTM-30 S 85° 31' 29.05" E D1st 3.7885	Curve FNLSTM-36 P.I. Station = 4401.28 N 282.972.1501 E 660.481.3191 Delta = 79° 21' 15.84" (RT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 4386.35 N 282.972.5052 E 660.476.7820 P.T. Station = 4404.33 N 282.967.6256 E 660.481.8082 C.C. = 4396.34 N 282.967.0359 E 660.476.3540 Back = S 85° 31' 29.05" E Ahead = S 6° 10' 13.22" E Chord Bear = S 45° 50' 51.13" E Course from PT FNLSTM-36 to PC FNLSTM-37 S 6° 10' 13.22" E D1st 3.7884	Curve FNLSTM-43 P.I. Station = 4479.74 N 282.928.6769 E 660.533.3848 Delta = 79° 21' 23.97" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5983 Radius = 5.4860 External = 1.6420 Long Chord = 7.0054 Mid. Ord. = 1.2637 P.C. Station = 4425.73 N 282.932.8716 E 660.531.6192 P.T. Station = 4476.73 N 282.929.6374 E 660.537.8333 C.C. = 4451.23 N 282.934.9998 E 660.536.6756 Back = S 22° 49' 36.59" E Ahead = N 77° 48' 59.44" E Chord Bear = S 62° 30' 18.58" E Course from PT FNLSTM-43 to PC FNLSTM-44 N 77° 48' 59.44" E D1st 3.7883	Curve FNLSTM-49 P.I. Station = 5443.51 N 282.896.3906 E 660.568.8722 Delta = 79° 21' 18.83" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5982 Radius = 5.4860 External = 1.6419 Long Chord = 7.0053 Mid. Ord. = 1.2637 P.C. Station = 5438.96 N 282.900.4594 E 660.570.9109 P.T. Station = 5446.56 N 282.894.0018 E 660.572.4944 C.C. = 5443.23 N 282.898.0018 E 660.575.8156 Back = S 26° 36' 49.79" W Ahead = S 52° 44' 30.15" E Chord Bear = S 13° 03' 50.18" E Course from PT FNLSTM-49 to PC FNLSTM-50 S 52° 44' 30.15" E D1st 3.7883	Curve FNLSTM-30 P.I. Station = 3432.96 N 283.013.6139 E 660.438.6097 Delta = 79° 21' 15.84" (RT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 3428.41 N 283.013.9690 E 660.434.0726 P.T. Station = 3436.01 N 283.009.0894 E 660.439.0988 C.C. = 3432.24 N 283.008.4997 E 660.433.6446 Back = S 85° 31' 29.05" E Ahead = S 6° 10' 13.22" E Chord Bear = S 45° 50' 51.13" E Course from PT FNLSTM-30 to PC FNLSTM-31 S 6° 10' 13.22" E D1st 3.7884	Curve FNLSTM-37 P.I. Station = 4412.87 N 282.959.3346 E 660.482.7045 Delta = 79° 21' 16.37" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 4408.12 N 282.963.8591 E 660.482.2154 P.T. Station = 4416.72 N 282.958.9795 E 660.487.2416 C.C. = 4412.44 N 282.964.4480 E 660.487.6696 Back = S 6° 10' 13.22" E Ahead = S 85° 31' 29.05" E Chord Bear = S 45° 50' 51.13" E Course from PT FNLSTM-37 to PC FNLSTM-38 S 85° 31' 29.05" E D1st 4.3192	Curve FNLSTM-44 P.I. Station = 4491.13 N 282.931.3974 E 660.545.9849 Delta = 79° 21' 23.97" (RT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5983 Radius = 5.4860 External = 1.6420 Long Chord = 7.0054 Mid. Ord. = 1.2637 P.C. Station = 4437.18 N 282.930.4369 E 660.541.5363 P.T. Station = 4488.18 N 282.927.2027 E 660.547.7504 C.C. = 4462.68 N 282.929.0745 E 660.542.6941 Back = N 77° 48' 59.44" E Ahead = S 22° 49' 36.59" E Chord Bear = S 62° 30' 18.58" E Course from PT FNLSTM-44 to PC FNLSTM-45 S 22° 49' 36.59" E D1st 3.7884	Curve FNLSTM-50 P.I. Station = 5443.51 N 282.896.3906 E 660.568.8722 Delta = 79° 21' 18.83" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5982 Radius = 5.4860 External = 1.6419 Long Chord = 7.0053 Mid. Ord. = 1.2637 P.C. Station = 5438.96 N 282.891.3419 E 660.575.5096 P.T. Station = 5446.56 N 282.884.5180 E 660.577.0930 C.C. = 5443.23 N 282.898.0018 E 660.572.1893 Back = S 26° 36' 49.79" W Ahead = S 52° 44' 30.15" E Chord Bear = S 13° 03' 50.18" E Course from PT FNLSTM-50 to PC FNLSTM-51 S 26° 36' 49.79" W D1st 3.8063
Curve FNLSTM-31 P.I. Station = 3444.35 N 283.000.7984 E 660.439.9951 Delta = 79° 21' 15.84" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 3439.80 N 283.005.3229 E 660.439.5060 P.T. Station = 3447.40 N 283.000.4433 E 660.444.5322 C.C. = 3442.10 N 283.005.9126 E 660.444.9602 Back = S 6° 10' 13.22" E Ahead = S 85° 31' 29.05" E Chord Bear = S 45° 50' 51.13" E Course from PT FNLSTM-31 to PC FNLSTM-32 S 85° 31' 29.05" E D1st 3.7884	Curve FNLSTM-38 P.I. Station = 4424.06 N 282.958.3288 E 660.495.5556 Delta = 72° 28' 40.94" (RT) Degree = 1044° 23' 59.71" Tangent = 4.0203 Length = 6.9390 Radius = 5.4860 External = 1.3164 Long Chord = 6.4866 Mid. Ord. = 1.0610 P.C. Station = 4420.04 N 282.958.6425 E 660.491.5476 P.T. Station = 4428.08 N 282.954.4124 E 660.496.4837 C.C. = 4424.06 N 282.953.1732 E 660.491.1195 Back = S 85° 31' 29.05" E Ahead = S 13° 03' 15.99" E Chord Bear = S 49° 17' 22.73" E Course from PT FNLSTM-38 to PC FNLSTM-39 S 13° 03' 15.99" E D1st 3.1082	Curve FNLSTM-45 P.I. Station = 5402.52 N 282.919.5164 E 660.550.9857 Delta = 79° 21' 24.11" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5983 Radius = 5.4860 External = 1.6420 Long Chord = 7.0054 Mid. Ord. = 1.2637 P.C. Station = 5397.77 N 282.923.7111 E 660.549.2201 P.T. Station = 5405.56 N 282.920.4769 E 660.555.4342 C.C. = 5401.64 N 282.925.8393 E 660.554.2765 Back = S 22° 49' 36.59" E Ahead = N 77° 48' 59.30" E Chord Bear = S 62° 30' 18.65" E Course from PT FNLSTM-45 to PC FNLSTM-46 N 77° 48' 59.30" E D1st 4.4853	Curve FNLSTM-51 P.I. Station = 5466.28 N 282.877.0622 E 660.573.3573 Delta = 112° 09' 57.33" (LT) Degree = 1879° 46' 58.05" Tangent = 4.5330 Length = 5.9670 Radius = 3.0480 External = 2.4144 Long Chord = 5.0587 Mid. Ord. = 1.3472 P.C. Station = 5461.75 N 282.881.1149 E 660.575.3879 P.T. Station = 5467.72 N 282.876.7107 E 660.577.8766 C.C. = 5464.74 N 282.879.7495 E 660.578.1130 Back = S 26° 36' 48.67" W Ahead = S 85° 33' 08.65" E Chord Bear = S 28° 28' 09.99" E Course from PT FNLSTM-51 to PC FNLSTM-52 S 85° 33' 08.65" E D1st 6.2916	Curve FNLSTM-32 P.I. Station = 3455.74 N 282.999.7926 E 660.452.8460 Delta = 79° 21' 15.25" (RT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 3451.19 N 283.000.1477 E 660.448.3090 P.T. Station = 3458.79 N 282.995.2681 E 660.453.3352 C.C. = 3454.99 N 282.994.6784 E 660.448.8810 Back = S 85° 31' 29.05" E Ahead = S 6° 10' 13.80" E Chord Bear = S 45° 50' 51.43" E Course from PT FNLSTM-32 to PC FNLSTM-33 S 6° 10' 13.80" E D1st 3.7884	Curve FNLSTM-39 P.I. Station = 4434.59 N 282.946.9980 E 660.498.1829 Delta = 89° 07' 40.94" (LT) Degree = 1253° 11' 18.70" Tangent = 4.5029 Length = 7.1121 Radius = 4.5720 External = 1.8451 Long Chord = 6.4164 Mid. Ord. = 3.1466 P.C. Station = 4430.08 N 282.951.3845 E 660.497.1658 P.T. Station = 4437.20 N 282.947.9482 E 660.502.5844 C.C. = 4434.59 N 282.952.4172 E 660.501.6196 Back = S 13° 03' 15.99" E Ahead = N 77° 49' 03.08" E Chord Bear = S 57° 37' 06.45" E Course from PT FNLSTM-39 to PC FNLSTM-40 N 77° 49' 03.08" E D1st 3.8366	Curve FNLSTM-46 P.I. Station = 5413.90 N 282.922.2369 E 660.563.5857 Delta = 92° 59' 20.52" (RT) Degree = 1566° 18' 51.72" Tangent = 3.8627 Length = 5.9368 Radius = 3.0480 External = 1.6558 Long Chord = 5.3064 Mid. Ord. = 1.1397 P.C. Station = 5409.18 N 282.921.4235 E 660.559.8185 P.T. Station = 5416.99 N 282.918.4324 E 660.564.2015 C.C. = 5413.90 N 282.917.8479 E 660.560.5905 Back = N 77° 48' 59.30" E Ahead = S 9° 11' 40.18" E Chord Bear = S 55° 41' 20.44" E Course from PT FNLSTM-46 to PC FNLSTM-47 S 9° 11' 40.18" E D1st 2.6169	Curve FNLSTM-52 P.I. Station = 5478.08 N 282.875.9068 E 660.588.2118 Delta = 73° 12' 27.57" (RT) Degree = 1044° 23' 59.71" Tangent = 4.0748 Length = 7.0095 Radius = 5.4860 External = 1.3478 Long Chord = 6.5424 Mid. Ord. = 1.0582 P.C. Station = 5474.01 N 282.876.2228 E 660.584.1493 P.T. Station = 5481.02 N 282.871.9262 E 660.589.0830 C.C. = 5478.08 N 282.870.7533 E 660.583.7238 Back = S 85° 33' 08.65" E Ahead = S 12° 20' 41.08" E Chord Bear = S 48° 56' 54.87" E Course from PT FNLSTM-52 to PC FNLSTM-53 S 12° 20' 41.08" E D1st 4.5142
Curve FNLSTM-33 P.I. Station = 3467.12 N 282.986.9771 E 660.454.2316 Delta = 79° 21' 15.68" (LT) Degree = 1044° 23' 59.71" Tangent = 4.5509 Length = 7.5981 Radius = 5.4860 External = 1.6419 Long Chord = 7.0052 Mid. Ord. = 1.2637 P.C. Station = 3462.57 N 282.991.5016 E 660.453.7424 P.T. Station = 3470.17 N 282.986.6220 E 660.458.7686 C.C. = 3467.12 N 282.992.0913 E 660.459.1966 Back = S 6° 10' 13.80" E Ahead = S 22° 49' 33.69" E Chord Bear = S 45° 50' 51.64" E Course from PT FNLSTM-33 to PC FNLSTM-34 S 85° 31' 29.48" E D1st 3.7885	Curve FNLSTM-40 P.I. Station = 4445.58 N 282.949.7182 E 660.510.7832 Delta = 79° 21' 23.24" (RT) Degree = 1044° 23' 59.71" Tangent = 4.5511 Length = 7.5983 Radius = 5.4860 External = 1.6420 Long Chord = 7.0054 Mid. Ord. = 1.2637 P.C. Station = 4441.03 N 282.948.7578 E 660.506.3347 P.T. Station = 4448.03 N 282.945.5236 E 660.512.5488 C.C. = 4445.58 N 282.943.3954 E 660.507.4924 Back = N 77° 49' 03.08" E Ahead = S 22° 49' 33.69" E Chord Bear = S 62° 30' 15.31" E Course from PT FNLSTM-40 to PC FNLSTM-41 S 22° 49' 33.69" E D1st 3.7881	Curve FNLSTM-47 P.I. Station = 5422.40 N 282.912.1054 E 660.565.2256 Delta = 56° 49' 38.46" (LT) Degree = 817° 20' 36.61" Tangent = 3.7925 Length = 6.9527 Radius = 7.0100 External = 0.9601 Long Chord = 6.4112 Mid. Ord. = 0.8445 P.C. Station = 5418.60 N 282.915.8491 E 660.564.6196 P.T. Station = 5425.56 N 282.910.5642 E 660.568.8908 C.C. = 5422.40 N 282.916.9832 E 660.571.5316 Back = S 9° 11' 40.18" E Ahead = S 9° 11' 40.18" E 					

	PROJECT REFERENCE NO.	SHEET NO.
	U-2527	2-F8
	R/W SHEET NO.	
	ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
	CONST. REV.	
R/W REV.		

PROPOSED STREAM CENTER LINE TRAVERSE

Curve Data

Curve FNLSTM-54
P.I. Station = 5+99.42 N 282,865.0508 E 660,602.1182
Delta = 63° 43' 17.27" (RT)
Degree = 93° 53' 29.03"
Tangent = 3.7886
Length = 6.7797
Radius = 6.0960
External = 1.0814
Long Chord = 6.4356
Mid. Ord. = 0.9185
P.C. Station = 5+35.63 N 282,864.4679 E 660,598.3747
P.T. Station = 6+02.41 N 282,861.9523 E 660,604.2983
C.C. = 5+69.02 N 282,858.4445 E 660,599.3127
Back = N 81° 08' 55.87" E
Ahead = S 35° 07' 46.86" E
Chord Bear = S 66° 59' 25.49" E

Course from PT FNLSTM-54 to PC FNLSTM-55 S 35° 07' 46.86" E Dist 3.6551

Curve Data

Curve FNLSTM-55
P.I. Station = 6+09.90 N 282,855.8220 E 660,608.6115
Delta = 80° 03' 37.20" (LT)
Degree = 125° 31' 18.10"
Tangent = 3.8405
Length = 6.3885
Radius = 4.5120
External = 1.3990
Long Chord = 5.8813
Mid. Ord. = 1.0712
P.C. Station = 6+06.06 N 282,858.9630 E 660,606.4016
P.T. Station = 6+12.45 N 282,857.4566 E 660,612.0867
C.C. = 6+09.25 N 282,857.4566 E 660,610.1408
Back = S 35° 07' 46.86" E
Ahead = N 64° 48' 35.95" E
Chord Bear = S 75° 09' 35.45" E

Course from PT FNLSTM-55 to PC FNLSTM-56 N 64° 48' 35.95" E Dist 2.0314

Curve Data

Curve FNLSTM-56
P.I. Station = 6+16.12 N 282,859.0180 E 660,615.4063
Delta = 33° 13' 49.30" (RT)
Degree = 104° 23' 59.71"
Tangent = 1.6370
Length = 3.1818
Radius = 5.4860
External = 0.2390
Long Chord = 3.1374
Mid. Ord. = 0.2291
P.C. Station = 6+14.48 N 282,858.3212 E 660,613.9249
P.T. Station = 6+17.67 N 282,858.7890 E 660,617.0272
C.C. = 6+16.07 N 282,853.3569 E 660,616.2599
Back = N 64° 48' 35.95" E
Ahead = S 81° 57' 34.75" E
Chord Bear = N 81° 25' 30.60" E

Course from PT FNLSTM-56 to 50005 S 81° 57' 34.75" E Dist 7.2853

Point 50005 N 282,857.7700 E 660,624.2409 Sta 6+24.95

Course from 50005 to 50006 S 82° 14' 40.64" E Dist 69.0442

Point 50006 N 282,848.4529 E 660,692.6536 Sta 6+94.00

Course from 50006 to PC FNLSTM-57 S 82° 14' 40.14" E Dist 14.5754

Curve Data

Curve FNLSTM-57
P.I. Station = 7+12.60 N 282,845.9426 E 660,711.0855
Delta = 95° 29' 37.31" (RT)
Degree = 156° 18' 51.72"
Tangent = 4.0267
Length = 6.0867
Radius = 3.6580
External = 1.7822
Long Chord = 5.4152
Mid. Ord. = 1.1983
P.C. Station = 7+08.57 N 282,846.4860 E 660,707.0957
P.T. Station = 7+14.67 N 282,842.0231 E 660,710.1627
C.C. = 7+11.58 N 282,842.8615 E 660,706.6020
Back = S 82° 14' 40.14" E
Ahead = S 13° 14' 57.21" W
Chord Bear = S 34° 29' 51.46" E

Course from PT FNLSTM-57 to PC FNLSTM-58 S 13° 14' 57.21" W Dist 2.8639

Curve Data

Curve FNLSTM-58
P.I. Station = 7+21.46 N 282,835.4113 E 660,708.6059
Delta = 99° 02' 27.31" (LT)
Degree = 170° 47' 29.46"
Tangent = 3.9287
Length = 5.7960
Radius = 3.3530
External = 1.8120
Long Chord = 5.1008
Mid. Ord. = 1.1763
P.C. Station = 7+17.53 N 282,839.2394 E 660,709.5063
P.T. Station = 7+23.33 N 282,835.1230 E 660,712.5240
C.C. = 7+20.43 N 282,838.4670 E 660,712.7701
Back = S 13° 14' 57.21" W
Ahead = S 65° 47' 30.10" E
Chord Bear = S 36° 16' 16.44" E

Course from PT FNLSTM-58 to PC FNLSTM-59 S 85° 47' 30.10" E Dist 3.1343

Curve Data

Curve FNLSTM-59
P.I. Station = 7+30.22 N 282,834.6173 E 660,719.3967
Delta = 89° 11' 49.71" (RT)
Degree = 150° 3' 49"
Tangent = 3.7570
Length = 5.9313
Radius = 3.8100
External = 1.5408
Long Chord = 5.3503
Mid. Ord. = 1.0971
P.C. Station = 7+26.46 N 282,834.8930 E 660,715.6498
P.T. Station = 7+32.39 N 282,830.8670 E 660,719.1735
C.C. = 7+29.42 N 282,831.0933 E 660,715.3702
Back = S 85° 47' 30.10" E
Ahead = S 3° 24' 19.61" W
Chord Bear = S 41° 11' 35.24" E

Course from PT FNLSTM-59 to PC FNLSTM-60 S 3° 24' 19.61" W Dist 4.5823

Curve Data

Curve FNLSTM-60
P.I. Station = 7+41.63 N 282,821.7498 E 660,718.6310
Delta = 79° 21' 18.96" (LT)
Degree = 104° 23' 59.71"
Tangent = 4.5509
Length = 7.5982
Radius = 5.4860
External = 1.6419
Long Chord = 7.0053
Mid. Ord. = 1.2637
P.C. Station = 7+36.98 N 282,826.2928 E 660,718.9013
P.T. Station = 7+44.57 N 282,820.6450 E 660,723.0458
C.C. = 7+41.78 N 282,825.9669 E 660,724.3776
Back = S 3° 24' 19.61" W
Ahead = S 75° 56' 59.34" E
Chord Bear = S 36° 16' 19.86" E

Course from PT FNLSTM-60 to PC FNLSTM-61 S 75° 56' 59.34" E Dist 3.7884

Curve Data

Curve FNLSTM-61
P.I. Station = 7+52.91 N 282,818.6205 E 660,731.1956
Delta = 79° 21' 17.04" (RT)
Degree = 104° 23' 59.71"
Tangent = 4.5509
Length = 7.5981
Radius = 5.4860
External = 1.6419
Long Chord = 7.0052
Mid. Ord. = 1.2637
P.C. Station = 7+48.36 N 282,819.7253 E 660,726.7208
P.T. Station = 7+55.96 N 282,814.0776 E 660,730.8553
C.C. = 7+52.16 N 282,814.4034 E 660,725.3890
Back = S 75° 56' 59.34" E
Ahead = S 3° 24' 17.70" W
Chord Bear = S 36° 16' 20.82" E

Course from PT FNLSTM-61 to PC FNLSTM-62 S 3° 24' 17.70" W Dist 3.7885

Curve Data

Curve FNLSTM-62
P.I. Station = 7+64.30 N 282,805.7529 E 660,730.3700
Delta = 79° 21' 18.36" (LT)
Degree = 104° 23' 59.71"
Tangent = 4.5509
Length = 7.5982
Radius = 5.4860
External = 1.6419
Long Chord = 7.0053
Mid. Ord. = 1.2637
P.C. Station = 7+59.75 N 282,810.2958 E 660,730.6403
P.T. Station = 7+67.35 N 282,804.6481 E 660,734.7848
C.C. = 7+64.55 N 282,809.3700 E 660,736.1166
Back = S 3° 24' 17.70" W
Ahead = S 75° 27' 00.66" E
Chord Bear = S 36° 16' 21.48" E

Course from PT FNLSTM-62 to PC FNLSTM-63 S 75° 27' 00.66" E Dist 3.7884

Curve Data

Curve FNLSTM-63
P.I. Station = 7+75.69 N 282,802.6236 E 660,742.8748
Delta = 79° 21' 21.81" (RT)
Degree = 104° 23' 59.71"
Tangent = 4.5510
Length = 7.5982
Radius = 5.4860
External = 1.6420
Long Chord = 7.0053
Mid. Ord. = 1.2637
P.C. Station = 7+71.14 N 282,803.7284 E 660,738.4599
P.T. Station = 7+78.73 N 282,798.0806 E 660,742.6044
C.C. = 7+75.94 N 282,798.4065 E 660,737.1281
Back = S 75° 27' 00.66" E
Ahead = S 3° 24' 21.15" W
Chord Bear = S 36° 16' 19.76" E

Course from PT FNLSTM-63 to PC FNLSTM-64 S 3° 24' 21.15" W Dist 4.1828

Curve Data

Curve FNLSTM-64
P.I. Station = 7+87.07 N 282,789.7563 E 660,742.1090
Delta = 74° 17' 45.52" (LT)
Degree = 104° 23' 59.71"
Tangent = 4.1563
Length = 7.1137
Radius = 5.4860
External = 1.3966
Long Chord = 6.6257
Mid. Ord. = 1.1132
P.C. Station = 7+82.92 N 282,793.9052 E 660,742.3559
P.T. Station = 7+90.08 N 282,788.3956 E 660,746.0362
C.C. = 7+87.50 N 282,793.5793 E 660,747.8322
Back = S 3° 24' 21.15" W
Ahead = S 70° 53' 24.38" E
Chord Bear = S 33° 44' 31.82" E

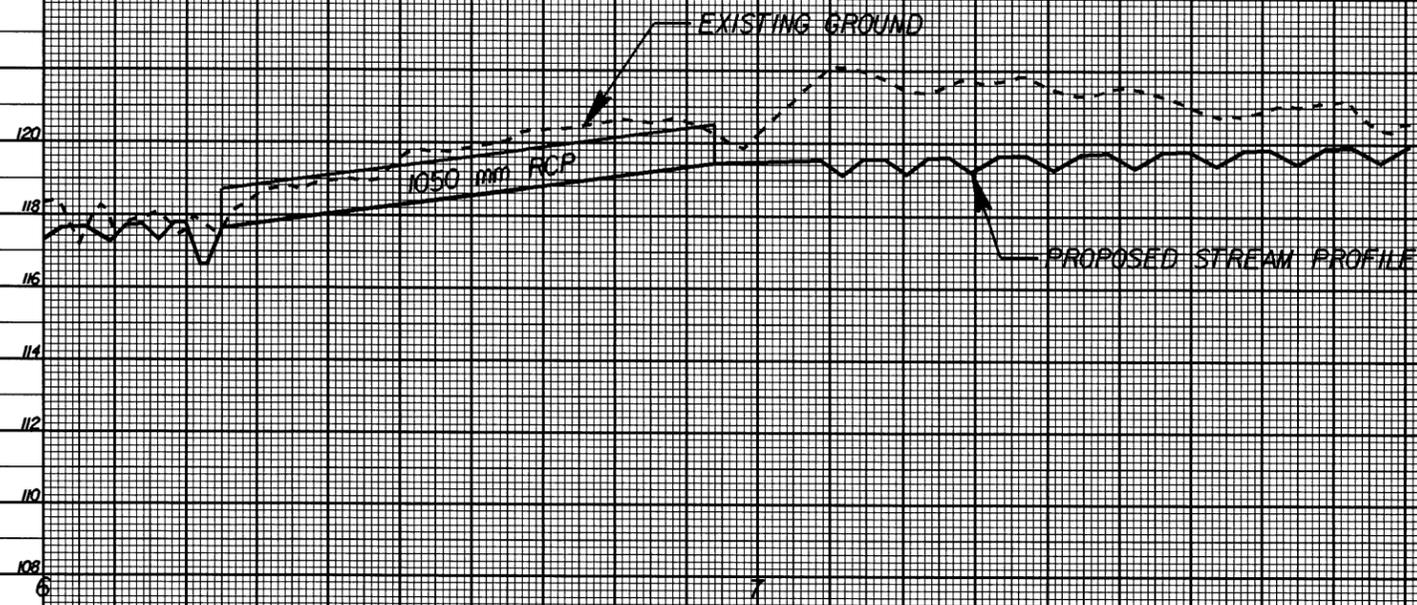
Course from PT FNLSTM-64 to 50007 S 70° 53' 24.38" E Dist 0.6097

Point 50007 N 282,788.1960 E 660,746.6123 Sta 7+90.64

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 Jacob
 11/11/2025



CONST. REV.
R/W REV.



wp1	stb	0+00.00	EL 107.06	CONFLU
wp2	stb	0+03.048	EL 107.118	HEAD RIFFLE
wp3	stb	0+05.080	EL 106.83	POOL
wp4	stb	0+08.382	EL 107.44	GRADE CONTROL LOW
wp5	stb	0+08.382	EL 107.371	GRADE CONTROL HIGH
wp6	stb	0+04.4	EL 107.066	POOL
wp7	stb	0+3.716	EL 107.398	GRADE CONTROL LOW
wp8	stb	0+3.716	EL 107.625	GRADE CONTROL HIGH
wp9	stb	0+5.748	EL 107.32	POOL
wp10	stb	0+9.050	EL 107.652	GRADE CONTROL LOW
wp11	stb	0+9.050	EL 107.879	GRADE CONTROL HIGH
wp12	stb	0+2.082	EL 107.574	POOL
wp13	stb	0+24.384	EL 107.905	GRADE CONTROL LOW
wp14	stb	0+24.384	EL 108.132	GRADE CONTROL HIGH
wp15	stb	0+26.46	EL 107.827	POOL
wp16	stb	0+23.718	EL 108.159	GRADE CONTROL LOW
wp17	stb	0+23.718	EL 108.386	GRADE CONTROL HIGH
wp18	stb	0+3.750	EL 108.08	POOL
wp19	stb	0+35.052	EL 108.43	GRADE CONTROL LOW
wp20	stb	0+35.052	EL 108.64	GRADE CONTROL HIGH
wp21	stb	0+37.084	EL 108.335	POOL
wp22	stb	0+40.386	EL 108.666	GRADE CONTROL LOW
wp23	stb	0+40.386	EL 108.893	GRADE CONTROL HIGH
wp24	stb	0+42.48	EL 108.588	POOL
wp25	stb	0+45.720	EL 108.92	GRADE CONTROL LOW
wp26	stb	0+45.720	EL 109.147	GRADE CONTROL HIGH
wp27	stb	0+48.710	EL 108.598	POOL #5
wp28	stb	0+52.578	EL 109.18	TOE RIFFLE
wp29	stb	0+56.446	EL 109.402	HEAD RIFFLE
wp30	stb	0+60.315	EL 108.853	POOL #6
wp31	stb	0+64.110	EL 109.44	TOE RIFFLE (LOW POINT)
wp32	stb	0+64.110	EL 109.592	TOE RIFFLE (HIGH POINT)
wp33	stb	0+67.905	EL 109.649	HEAD RIFFLE
wp34	stb	0+71.700	EL 109.1	POOL #7
wp35	stb	0+75.205	EL 109.686	TOE RIFFLE (LOW POINT)
wp36	stb	0+75.205	EL 109.838	TOE RIFFLE (HIGH POINT)
wp37	stb	0+78.710	EL 109.89	HEAD RIFFLE
wp38	stb	0+82.215	EL 109.342	POOL #8
wp39	stb	0+85.692	EL 109.926	TOE RIFFLE
wp40	stb	0+89.169	EL 109.978	HEAD RIFFLE
wp41	stb	0+92.645	EL 109.429	POOL #9
wp42	stb	0+96.557	EL 110.015	TOE RIFFLE
wp43	stb	0+100.469	EL 110.074	HEAD RIFFLE
wp44	stb	0+104.380	EL 109.525	POOL #10
wp45	stb	0+108.292	EL 110.112	TOE RIFFLE
wp46	stb	0+112.204	EL 110.171	HEAD RIFFLE
wp47	stb	0+116.116	EL 109.628	POOL #11
wp48	stb	0+120.028	EL 110.203	TOE RIFFLE

wp49	stb	0+22.604	EL 110.239	HEAD RIFFLE
wp50	stb	0+26.185	EL 109.69	POOL #12
wp51	stb	0+29.772	EL 110.275	TOE RIFFLE
wp52	stb	0+36.630	EL 110.344	HEAD RIFFLE
wp53	stb	0+39.164	EL 109.795	POOL #13
wp54	stb	0+41.698	EL 110.369	TOE RIFFLE (LOW POINT)
wp55	stb	0+41.698	EL 110.521	TOE RIFFLE (HIGH POINT)
wp56	stb	0+45.466	EL 110.578	HEAD RIFFLE
wp57	stb	0+49.235	EL 110.029	POOL #14
wp58	stb	0+52.980	EL 110.616	TOE RIFFLE (LOW POINT)
wp59	stb	0+52.980	EL 110.768	TOE RIFFLE (HIGH POINT)
wp60	stb	0+56.725	EL 110.824	HEAD RIFFLE
wp61	stb	0+60.470	EL 110.275	POOL #15
wp62	stb	0+64.217	EL 110.862	TOE RIFFLE (LOW POINT)
wp63	stb	0+64.217	EL 111.014	TOE RIFFLE (HIGH POINT)
wp64	stb	0+68.184	EL 111.072	HEAD RIFFLE
wp65	stb	0+72.040	EL 110.523	POOL #16
wp66	stb	0+75.837	EL 111.11	TOE RIFFLE (LOW POINT)
wp67	stb	0+75.837	EL 111.262	TOE RIFFLE (HIGH POINT)
wp68	stb	0+79.634	EL 111.319	HEAD RIFFLE
wp69	stb	0+83.430	EL 110.77	POOL #17
wp70	stb	0+87.228	EL 111.347	TOE RIFFLE
wp71	stb	0+91.026	EL 111.404	HEAD RIFFLE
wp72	stb	0+94.825	EL 110.855	POOL #18
wp73	stb	0+98.622	EL 111.442	TOE RIFFLE (LOW POINT)
wp74	stb	0+98.622	EL 111.594	TOE RIFFLE (HIGH POINT)
wp75	stb	0+102.419	EL 111.651	HEAD RIFFLE
wp76	stb	0+106.215	EL 111.102	POOL #19
wp77	stb	0+110.012	EL 111.689	TOE RIFFLE
wp78	stb	0+113.809	EL 111.746	HEAD RIFFLE
wp79	stb	0+117.605	EL 111.197	POOL #20
wp80	stb	0+121.402	EL 111.784	TOE RIFFLE
wp81	stb	0+125.199	EL 111.841	HEAD RIFFLE
wp82	stb	0+128.995	EL 111.292	POOL #21
wp83	stb	0+132.792	EL 111.879	TOE RIFFLE (LOW POINT)
wp84	stb	0+132.792	EL 112.031	TOE RIFFLE (HIGH POINT)
wp85	stb	0+136.589	EL 112.088	HEAD RIFFLE
wp86	stb	0+140.385	EL 111.539	POOL #22
wp87	stb	0+144.182	EL 112.126	TOE RIFFLE
wp88	stb	0+147.979	EL 112.183	HEAD RIFFLE
wp89	stb	0+151.775	EL 111.634	POOL #23
wp90	stb	0+155.572	EL 112.221	TOE RIFFLE
wp91	stb	0+159.369	EL 112.278	HEAD RIFFLE
wp92	stb	0+163.165	EL 111.729	POOL #24
wp93	stb	0+166.963	EL 112.276	TOE RIFFLE
wp94	stb	0+170.76	EL 112.373	HEAD RIFFLE
wp95	stb	0+174.556	EL 111.824	POOL #25

wp96	stb	0+178.357	EL 112.41	TOE RIFFLE (LOW POINT)
wp97	stb	0+178.357	EL 112.563	TOE RIFFLE (HIGH POINT)
wp98	stb	0+182.154	EL 112.62	HEAD RIFFLE
wp99	stb	0+185.950	EL 112.071	POOL #26
wp100	stb	0+189.747	EL 112.658	TOE RIFFLE
wp101	stb	0+193.544	EL 112.715	HEAD RIFFLE
wp102	stb	0+197.340	EL 112.166	POOL #27
wp103	stb	0+201.137	EL 112.754	TOE RIFFLE (LOW POINT)
wp104	stb	0+201.137	EL 112.906	TOE RIFFLE (HIGH POINT)
wp105	stb	0+204.934	EL 112.965	HEAD RIFFLE
wp106	stb	0+208.730	EL 112.416	POOL #28
wp107	stb	0+212.527	EL 113.004	TOE RIFFLE
wp108	stb	0+216.324	EL 113.031	HEAD RIFFLE
wp109	stb	0+220.120	EL 112.482	POOL #29
wp110	stb	0+223.917	EL 113.069	TOE RIFFLE
wp111	stb	0+227.714	EL 113.095	HEAD RIFFLE
wp112	stb	0+231.510	EL 112.546	POOL #30
wp113	stb	0+235.307	EL 113.133	TOE RIFFLE
wp114	stb	0+239.104	EL 113.159	HEAD RIFFLE
wp115	stb	0+242.900	EL 112.61	POOL #31
wp116	stb	0+246.697	EL 113.197	TOE RIFFLE
wp117	stb	0+250.494	EL 113.223	HEAD RIFFLE
wp118	stb	0+254.290	EL 112.674	POOL #32
wp119	stb	0+258.087	EL 113.261	TOE RIFFLE
wp120	stb	0+261.884	EL 113.291	HEAD RIFFLE
wp121	stb	0+265.680	EL 112.742	POOL #33
wp122	stb	0+269.477	EL 113.329	TOE RIFFLE
wp123	stb	0+273.274	EL 113.386	HEAD RIFFLE
wp124	stb	0+277.070	EL 112.837	POOL #34
wp125	stb	0+280.867	EL 113.424	TOE RIFFLE
wp126	stb	0+284.664	EL 113.481	HEAD RIFFLE
wp127	stb	0+288.460	EL 112.932	POOL #35
wp128	stb	0+292.257	EL 113.519	TOE RIFFLE (LOW POINT)
wp129	stb	0+296.054	EL 113.748	TOE RIFFLE (HIGH POINT)
wp130	stb	0+299.850	EL 113.805	HEAD RIFFLE
wp131	stb	0+303.647	EL 113.256	POOL #36
wp132	stb	0+307.444	EL 113.843	TOE RIFFLE (LOW POINT)
wp133	stb	0+311.240	EL 114.418	TOE RIFFLE (HIGH POINT)
wp134	stb	0+315.037	EL 114.205	HEAD RIFFLE
wp135	stb	0+318.834	EL 113.656	POOL #37
wp136	stb	0+322.630	EL 114.243	TOE RIFFLE (LOW POINT)
wp137	stb	0+326.427	EL 114.472	TOE RIFFLE (HIGH POINT)
wp138	stb	0+330.224	EL 114.539	HEAD RIFFLE
wp139	stb	0+334.020	EL 113.99	POOL #38
wp140	stb	0+337.817	EL 114.575	TOE RIFFLE (LOW POINT)
wp141	stb	0+341.614	EL 114.754	TOE RIFFLE (HIGH POINT)
wp142	stb	0+345.410	EL 114.202	HEAD RIFFLE

wp143	stb	0+349.207	EL 114.263	POOL #39
wp144	stb	0+353.004	EL 114.848	TOE RIFFLE (LOW POINT)
wp145	stb	0+356.800	EL 115.085	TOE RIFFLE (HIGH POINT)
wp146	stb	0+360.597	EL 115.151	HEAD RIFFLE
wp147	stb	0+364.394	EL 114.601	POOL #40
wp148	stb	0+368.190	EL 115.188	TOE RIFFLE (LOW POINT)
wp149	stb	0+371.987	EL 115.44	TOE RIFFLE (HIGH POINT)
wp150	stb	0+375.784	EL 115.506	HEAD RIFFLE
wp151	stb	0+379.580	EL 114.957	POOL #41
wp152	stb	0+383.377	EL 115.544	TOE RIFFLE (LOW POINT)
wp153	stb	0+387.174	EL 115.698	TOE RIFFLE (HIGH POINT)
wp154	stb	0+390.970	EL 115.764	HEAD RIFFLE
wp155	stb	0+394.767	EL 115.215	POOL #42
wp156	stb	0+398.564	EL 115.802	TOE RIFFLE (LOW POINT)
wp157	stb	0+402.360	EL 115.944	TOE RIFFLE (HIGH POINT)
wp158	stb	0+406.157	EL 116.01	HEAD RIFFLE
wp159	stb	0+409.954	EL 115.461	POOL #43
wp160	stb	0+413.750	EL 116.048	TOE RIFFLE (LOW POINT)
wp161	stb	0+417.547	EL 116.344	TOE RIFFLE (HIGH POINT)
wp162	stb	0+421.344	EL 116.4	HEAD RIFFLE
wp163	stb	0+425.140	EL 115.891	POOL #44
wp164	stb	0+428.937	EL 116.448	TOE RIFFLE
wp165	stb	0+432.734	EL 116.513	HEAD RIFFLE
wp166	stb	0+436.530	EL 115.964	POOL #45
wp167	stb	0+440.327	EL 116.551	TOE RIFFLE
wp168	stb	0+444.124	EL 116.615	HEAD RIFFLE
wp169	stb	0+447.920	EL 116.066	POOL #46
wp170	stb	0+451.717	EL 116.649	TOE RIFFLE
wp171	stb	0+455.514	EL 116.715	HEAD RIFFLE
wp172	stb	0+459.310	EL 116.166	POOL #47
wp173	stb	0+463.107	EL 116.731	TOE RIFFLE
wp174	stb	0+466.904	EL 116.783	HEAD RIFFLE
wp175	stb	0+470.700	EL 116.234	POOL #48
wp176	stb	0+474.497	EL 116.818	TOE RIFFLE
wp177	stb	0+478.294	EL 116.882	HEAD RIFFLE
wp178	stb	0+482.090	EL 116.333	POOL #49
wp179	stb	0+485.887	EL 116.92	TOE RIFFLE
wp180	stb	0+489.684	EL 116.985	HEAD RIFFLE
wp181	stb	0+493.480	EL 116.436	POOL #50
wp182	stb	0+497.277	EL 117.021	TOE RIFFLE
wp183	stb	0+501.074	EL 117.082	HEAD RIFFLE
wp184	stb	0+504.870	EL 117.533	POOL #51
wp185	stb	0+508.667	EL 117.121	TOE RIFFLE (LOW POINT)
wp186	stb	0+512.464	EL 117.254	TOE RIFFLE (HIGH POINT)
wp187	stb	0+516.260	EL 117.296	HEAD RIFFLE
wp188	stb	0+520.057	EL 116.747	POOL #52
wp189	stb	0+523.854	EL 117.336	TOE RIFFLE (LOW POINT)

wp190	stb	0+527.650	EL 117.459	TOE RIFFLE (HIGH POINT)
wp191	stb	0+531.447	EL 117.525	HEAD RIFFLE
wp192	stb	0+535.244	EL 116.976	POOL #53
wp193	stb	0+539.040	EL 117.561	TOE RIFFLE
wp194	stb	0+542.837	EL 117.601	HEAD RIFFLE
wp195	stb	0+546.634	EL 117.052	POOL #54
wp196	stb	0+550.430	EL 117.635	TOE RIFFLE
wp197	stb	0+554.227	EL 117.676	HEAD RIFFLE
wp198	stb	0+558.024	EL 117.127	POOL #55
wp199	stb	0+561.820	EL 117.704	TOE RIFFLE
wp200	stb	0+565.617	EL 117.732	HEAD RIFFLE
wp201	stb	0+569.414	EL 117.183	POOL #56
wp202	stb	0+573.210	EL 117.792	HEAD OF STRUCTURE
wp203	stb	0+577.007	EL 117.792	BEGIN APRON
wp204	stb	0+580.804	EL 116.64	POOL
wp205	stb	0+584.600	EL 116.64	POOL
wp206	stb	0+588.397	EL 117.64	PIPE INV. OUT
wp207	stb	0+592.194	EL 119.457	

